

Electric Point Machine Westinghouse Style M70 MK III

TMG E1583

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Owner Chief Engineer Signals

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1 Assembled and Exploded Views Westinghouse 'M70' MKIII Point Machine

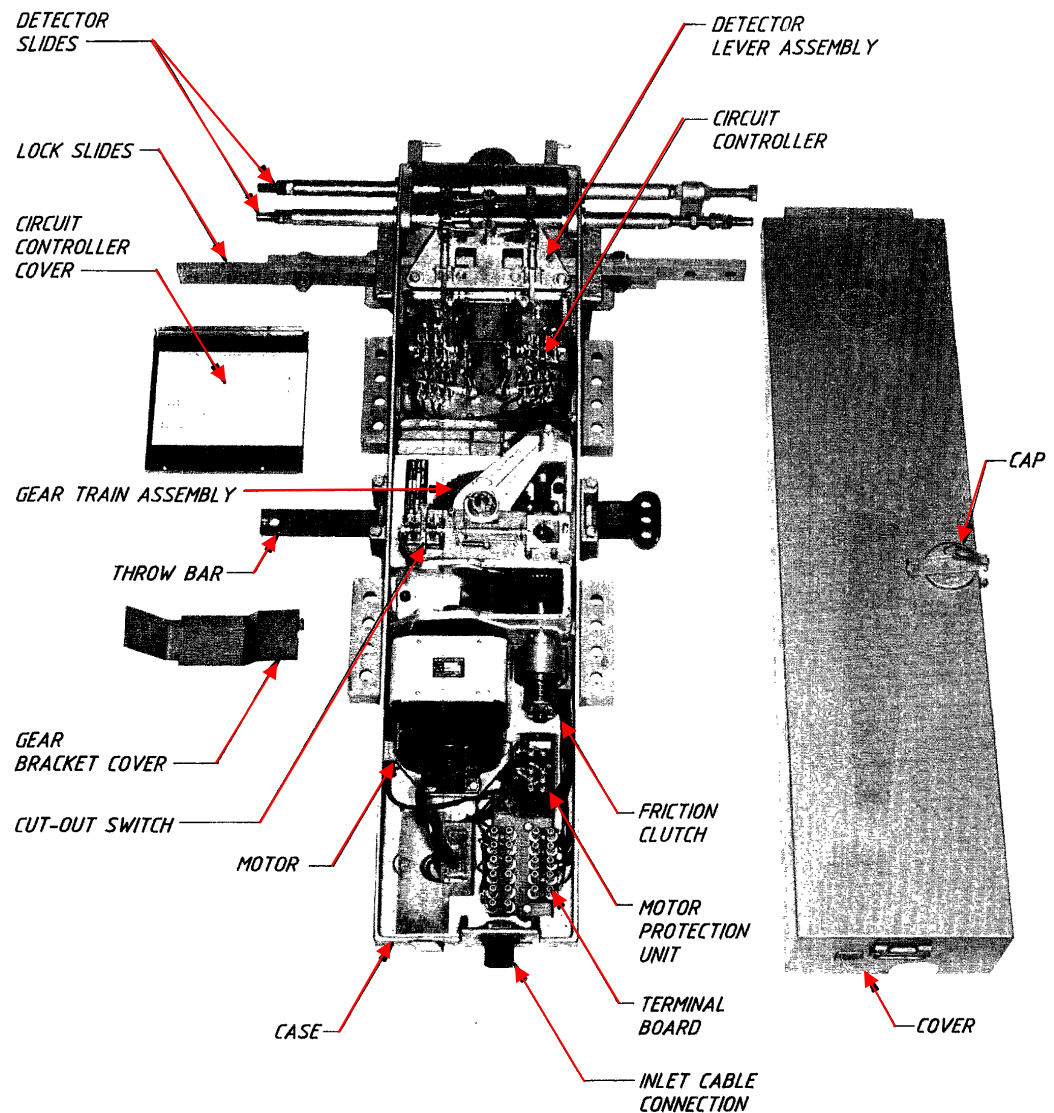


Figure 1.1

Assembled View

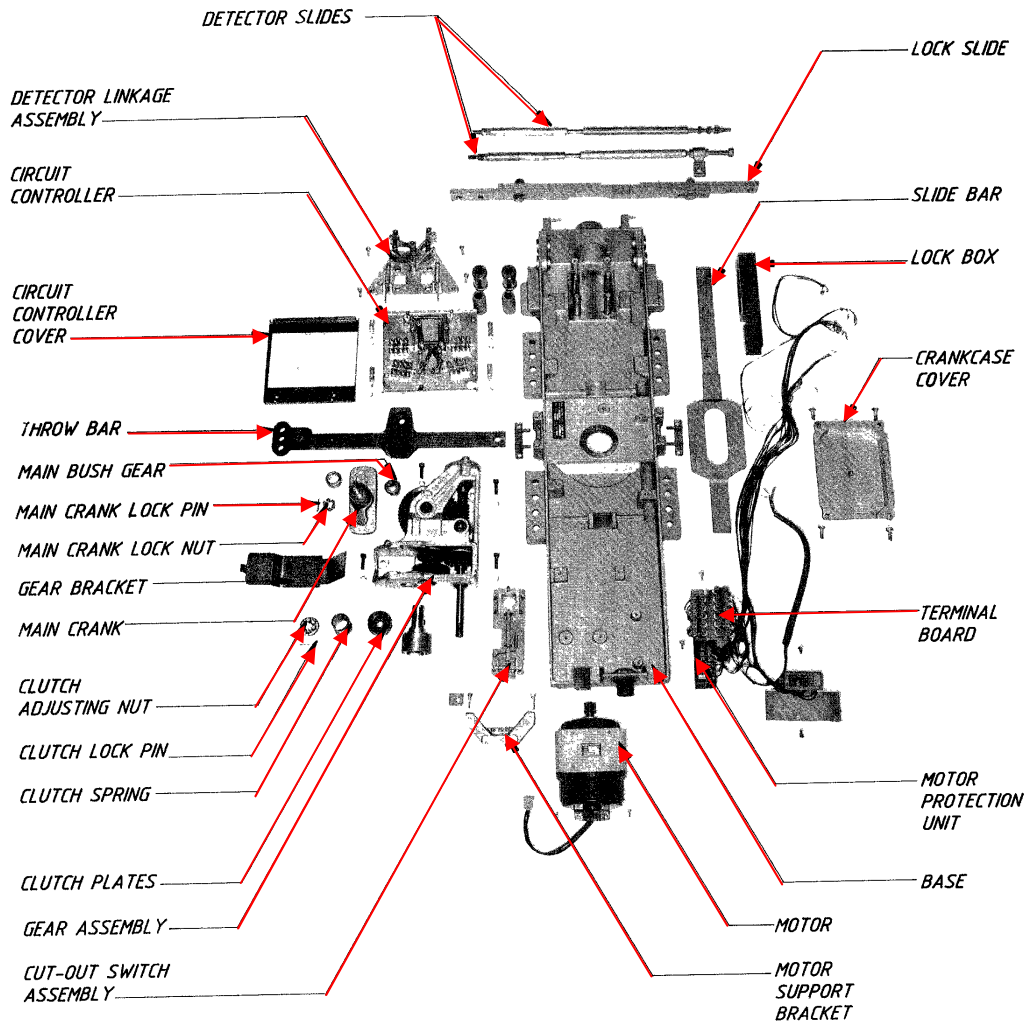


Figure 1.2
Exploded View

2 General Description, Operation, Installation and Wiring

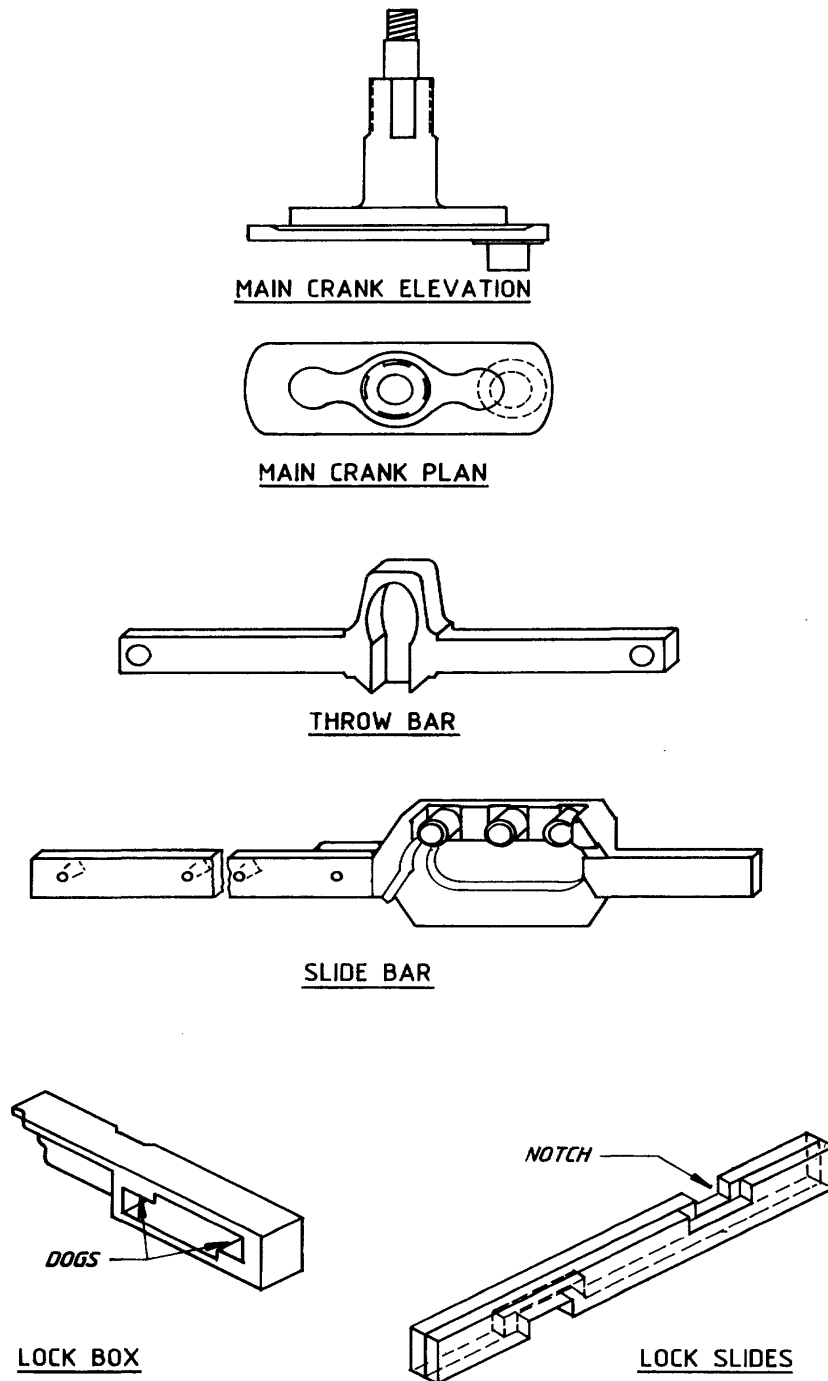


Figure 2.1

Main Components of Throw and Lock Mechanism

2.1 General Description

The Westinghouse Brake & Signal Co. "M70" Mk III point machine is similar in design to the McKenzie and Holland Style 'M' machines. It comprises a throw and lock mechanism driven by an electric motor, both of which are housed in a single cast iron casing. The casing also houses a motor protection unit, a circuit controller, points detection mechanism and a point contactor.

The motor drives the throw and lock mechanism through a spur gear train which incorporates a friction clutch and a worm gear drive to engage the main crank. The main crank drives the throw bar and the slide bar to which the lock box is attached. The lock slides engage the lock box to positively lock the mechanism.

The locking mechanism is of the 'straight through' type, with the lock slides having one notch on the top and one notch on the bottom, which engage corresponding lock dogs on each end of the lock box, ensuring that the machine cannot complete its travel unless the lock slides correspond to the position of the points.

The circuit controller incorporates motor and detection contacts, which check that the points are closed and locked in their correct position.

The motor protection unit is located near the motor and the point controller. For protection of the motor, the motor circuit is switched off automatically by the motor protection unit when operation takes abnormally long. The point contactor determines the switching direction of the motor.

A heavy gauge sheet steel cover with a moulded neoprene gasket provides ample protection and a granulated cork coating on the inside crank inhibits condensation. The cover, which is hinged at one end, can be removed completely and has a hasp and staple for padlocking.

Emergency manual operation is achieved by inserting a hand crank through a separately covered hole in the main cover.



2.2 Operation

The components of the main operating mechanism are shown in Figure 2.1.

The operation of the mechanism when power is applied to the main crank is shown in Figure 2.2 and is described below:

1. Normal position (Figure 2.2-1)

A reverse movement is commenced by a clockwise rotation of the main crank. Unlocking of the lock slide is achieved through the action of the lug on the upper side of the main crank against the rollers on the slide bar. This causes the slide bar to move thereby unlocking the lock box from the lock slide. Simultaneously, the roller on the underside of the crank moves through an arc of 40 degrees in the radial section of the escapement of the throw bar, thus freeing the throw bar for the reverse stroke. During the next 140 degrees of revolution of the main crank, the roller engages the straight section of the escapement of the throw bar, which moves the throw bar into the reverse position.

2. Intermediate Position (Figure 2.2-2)

At the intermediate position the crank is still rotating but is not transmitting motion to the slide bar as the lug on the crank has become disengaged from the rollers. Movement of the slide is prevented by the action of the ends of the crank on surfaces X and Y of the slide bar, which are now radial to the centre of the shaft. Motion of the throw bar is occurring by action of the roller on the escapement of the throw bar.

3. Reverse Position (Figure 2.2-3)

The roller on the underside of the main crank has thrown the throw bar into the reverse position and secured it by entering radial section of the throw bar escapement. The opposite lug at the top of the crank has engaged the rollers on the slide bar and moved the slide bar and the lock box into the reverse position. The lock box has engaged the notch in the lock slide, which has also been moved into the reverse position by the action of the points.

4. Locking

The locking of the lock slides in the lock box is achieved by means of two lock dogs in opposite ends of the lock box, one at the top and one at the bottom. The lock slides have corresponding notches cut in the top and bottom of the slides. Positive locking in both normal and reverse positions is achieved by engagement of the dog in the notch.

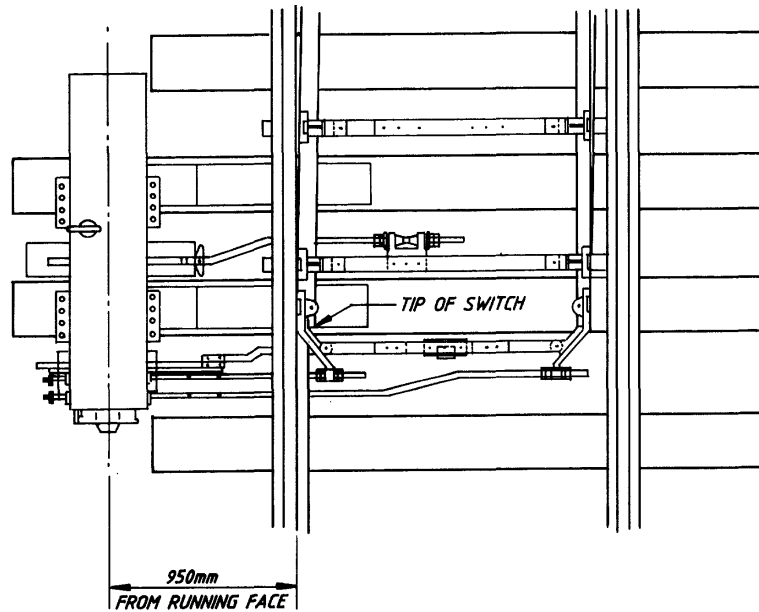


Figure 2.3.1

Left Hand Layout of Style 'M70' MKIII

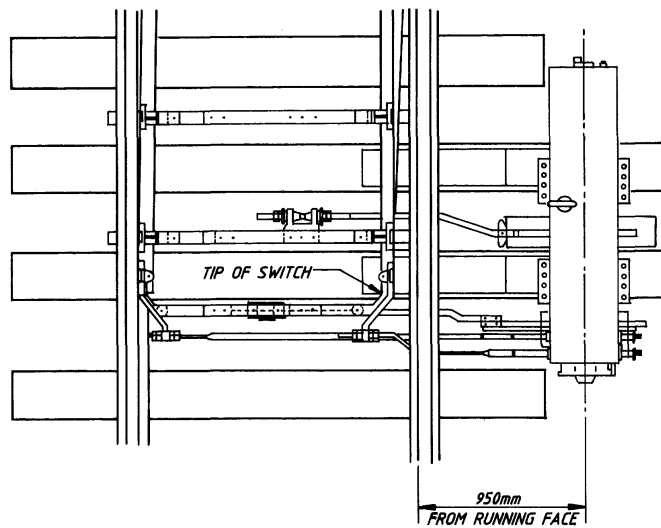


Figure 2.3.2

Right Hand Layout of Style 'M70' MKIII

2.3 Installation

The right and left hand layouts of the M70 MKIII point machine are illustrated in Figures 2.3.1 and 2.3.2. For complete details of layouts refer to "Switch and Detail Layouts — Power Operation Book" (SRA publication).

2.3.1 Installation of Machine

(a) Preparation Instructions

The following instructions outline the necessary preparation prior to installation of the point machine.

1. Ballasting, tamping and alignment of track to be completed by the civil maintainer.
2. Excess ballast is to be removed to allow free movement of switches and connecting rods. Particular attention should be given to small particles of ballast under the switches. This will be evident when the switches are moved back and forth.
3. Check that heel blocks (if fitted), studs at each chair and all rail fastenings are secure.
4. Check that switches are square at point of switches.
5. Move each switch independently and check that they bear evenly on each chair A, B, C, D.
6. Each switch should move freely and fit evenly against the stock rail without undue force.
7. Any defects regarding the above steps should be brought to the attention of the civil maintainer.

NOTE: When operating points by hand prior to connection of the points machine the same effort should apply to both normal and reverse position.

(b) Installation Procedure

1. Fit front rod.
2. Fit back rod.
3. Fit additional back rods 3rd and 4th if required depending on switch length.
4. Fit cradle to front rod.
5. Fit extension pieces to N and R switches.
6. Fit lock rod.
7. Adjust point opening to 115mm (4 1/2").
8. Bar points to both normal and reverse and ensure they bear evenly on the stock rails without having to exert undue pressure.
9. Fit tie plates to rail brace chairs on scarfed timbers (note insulation to be provided).

10. Fit and align switch machines on tie plates.
11. Drill 4 x 21mm holes through tie plates and scarfed timber.
12. Fit switch machine using specified hexagon bolts with headlock washers underneath, round and spring washer on top.
13. Assemble lock and detector slides to machine as described in Section 2.3.3 A and B.
14. Fit point driving rod with bobbins to cradle and throw bar of machine.
15. Crank machine both to normal and reverse positions, and adjust spring on points.
Note: Excessive spring should be avoided.
16. Fit lock driving rod and adjust normal and reverse facing point locks according to Section 4.3.3.
17. Fit normal and reverse detector rods, note that sleeve bearings must be used on each rod.
18. Adjust detector slides according to Section 4.4.2.

Check that all fittings, lock nuts on switch connections, and adjustments are correct.

Points are now ready for power operation and are to be tested for correct operation using manual cranking.

21. When all connections and adjustments have been made, track movement and heel condition should be observed under traffic and any problems brought to the attention of the civil maintainer.
22. Forty eight hours after installation, the points adjustment must again be checked and the operation observed under traffic to ensure that no settling of the track has occurred.

2.3.2 Timber Details

The details of the timbers on which the machine is mounted are shown in Figure 2.3.2.

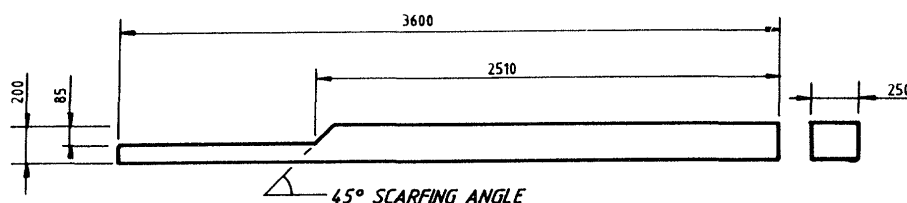


Figure 2.3.2

Mounting Timber Details

2.3.3 Installation of Lock and Detector Slides

A Installation of Lock Slides

1. Assemble lock slides with serrations together.
2. Using manual operation, throw the switch to the mid-stroke position.
3. Insert slides into machine so that serrations are on left hand side of machine viewed from detector end and the bar with long set of serrations facing towards same end of the machine.
4. Fit drop lug to appropriate end of bar and connect to points.
5. Adjust lock slides according to Section 4.3.2.

B Installation of Detector Slides

1. Insert detector slides into machine with long threaded end for drop lug towards points.
2. Connect to points and adjust according to Section 4.4.2.

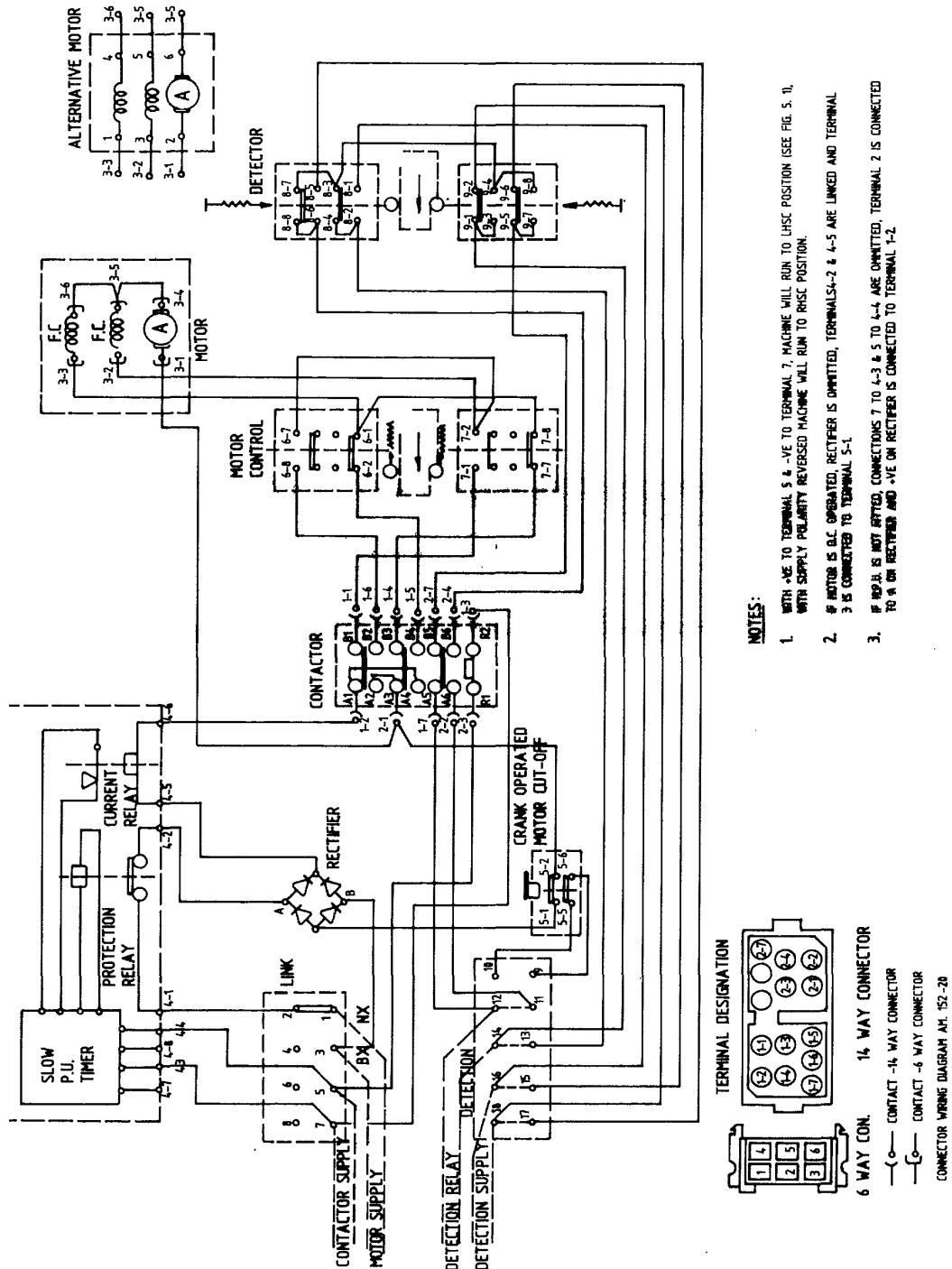


Figure 2.4

Internal Wiring Diagram 'M70' MKIII

2.4 Wiring

The internal wiring is in high temperature PVC insulated wire, 50/02.mm (70/.0076) for motor circuits and 30/0.2mm (40/.0076) for control and detection circuits. Wiring between the terminal board and the circuit controller is protected by a rigid PVC conduit. A 51 mm (inside diameter) flexible conduit connection is provided near the terminal board for incoming wires.

The point machines are wired to short-circuit the detection relay(s) while the detection is open. If this is not required, remove the three links between 9-8 and 9-4, 9-4 and 8-3, 8-3 and 8-7 on the detector switches.

The internal wiring diagram for the point machine is given in Figure 2.4.

3 Major Specifications

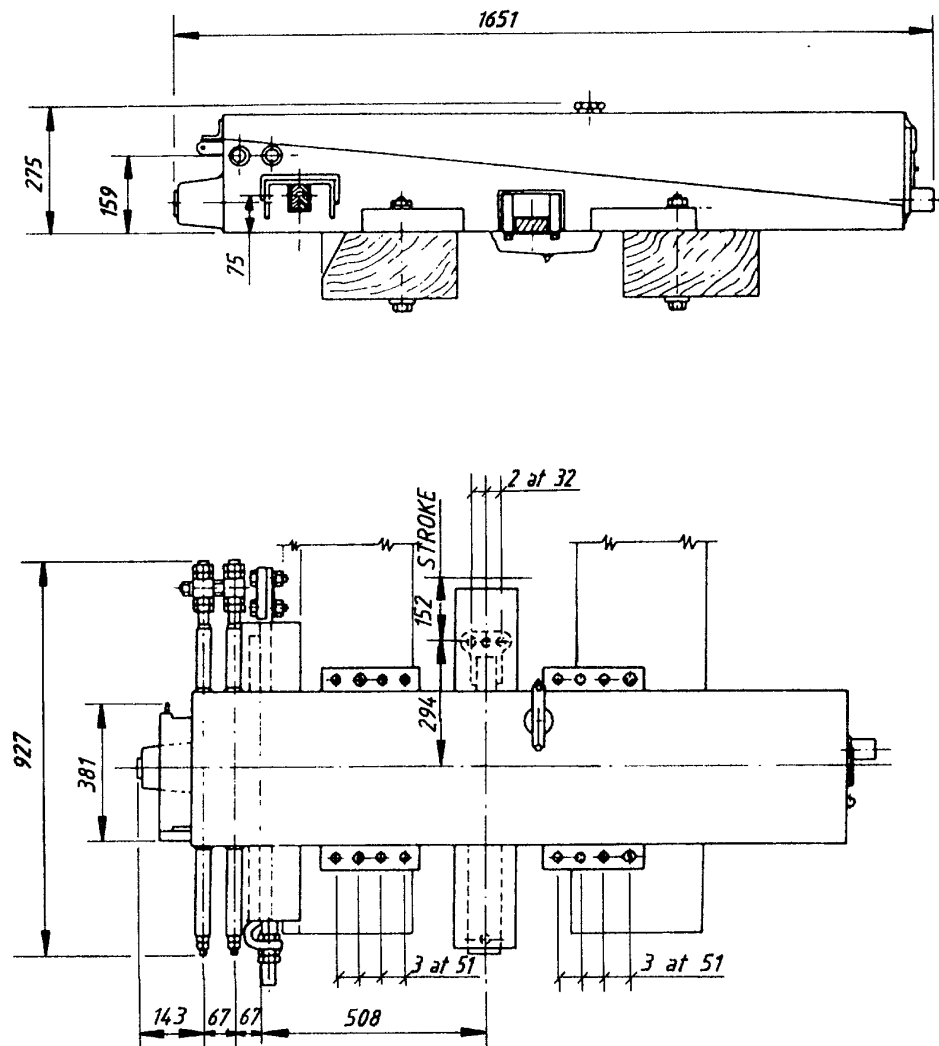


Figure 3.1

Overall Dimensions

3.1 Technical Details

The technical information describing the 'M70' MKIII point machine is tabulated in Table 3.1.

Table 3.1 M70 MKIII Point Machine Technical Information

Item	Description
Motor	110V, D.C., Split Field
Point Controller Thrust Rated	50V, D.C.
Thrust Rated	3000N Approx.
Thrust Maximum	4500N Approx.
Gear Box Ratio Operating Time	112:1
Ambient Temperature Range	4 Seconds at rated voltage - 10 to 60 degree C.
Weight	214 kg. approximately
Dimensions	Refer to Figure 3.1.
Motor Protection Unit	50V D.C
Cut-off Time	10 seconds (+25% -25%) \pm 25%

4 Components – Replacement, Servicing and Adjustments

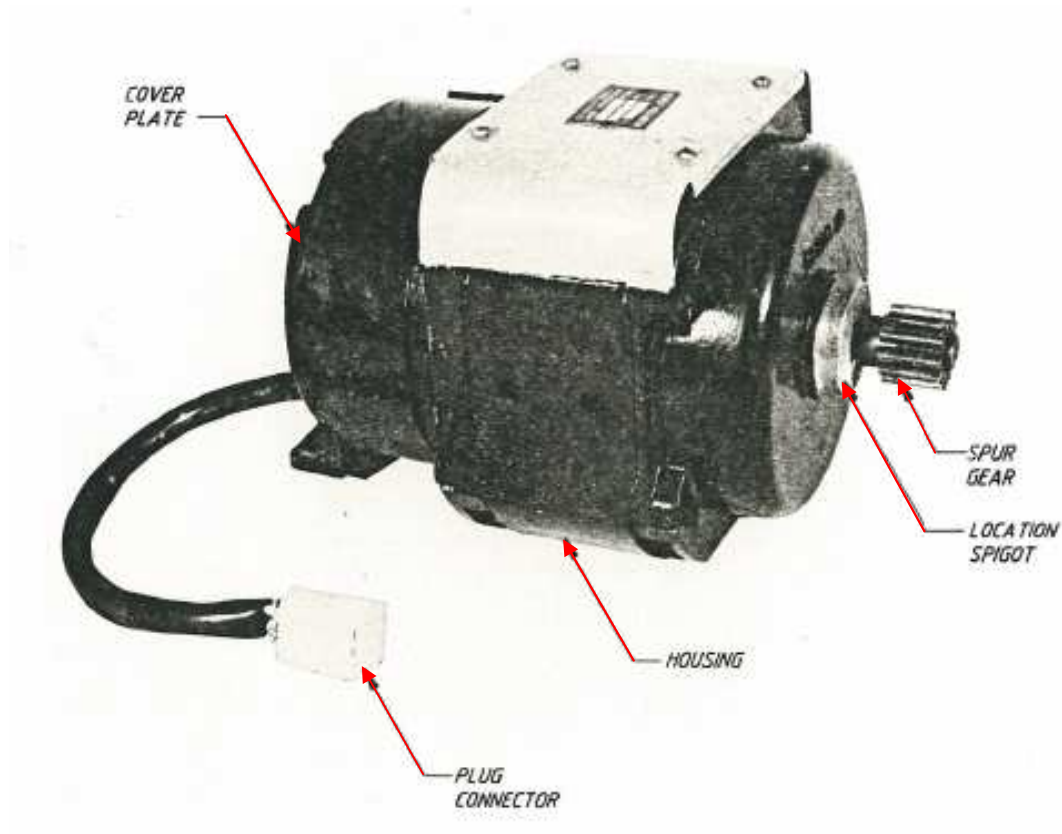


Figure 4.1.1

Motor M70 MKIII

4.1 Motor

4.1.1 Description

The point machine is fitted with a plug-connected series-wound motor, as shown in Figure 4.1.1. The split field enables a regenerative braking circuit to provide snubbing at the end of the stroke. The plug connector is indexed to prevent use of a wrong type motor. If required, the machine can also be fitted with a 110V DC, AC immune permanent magnet motor.

4.1.2 Removal and Replacement

1. Unplug the lead from the terminal board.
2. Remove the two bolts from the baseplate.
3. Slide the motor towards the end of the machine until the spur gear disengages from the gear cluster and then remove the motor.
4. Replacement involves the above procedures in reverse order. Care should be taken to ensure that the spur gear meshes properly and that the location spigot seats properly before bolting down.

4.1.3 Overhaul

The operation of the motor should be observed during normal monthly maintenance visits. If it shows signs of abnormal noise, slackness in the bearings or heavy burning of the commutator, the motor should be exchanged.

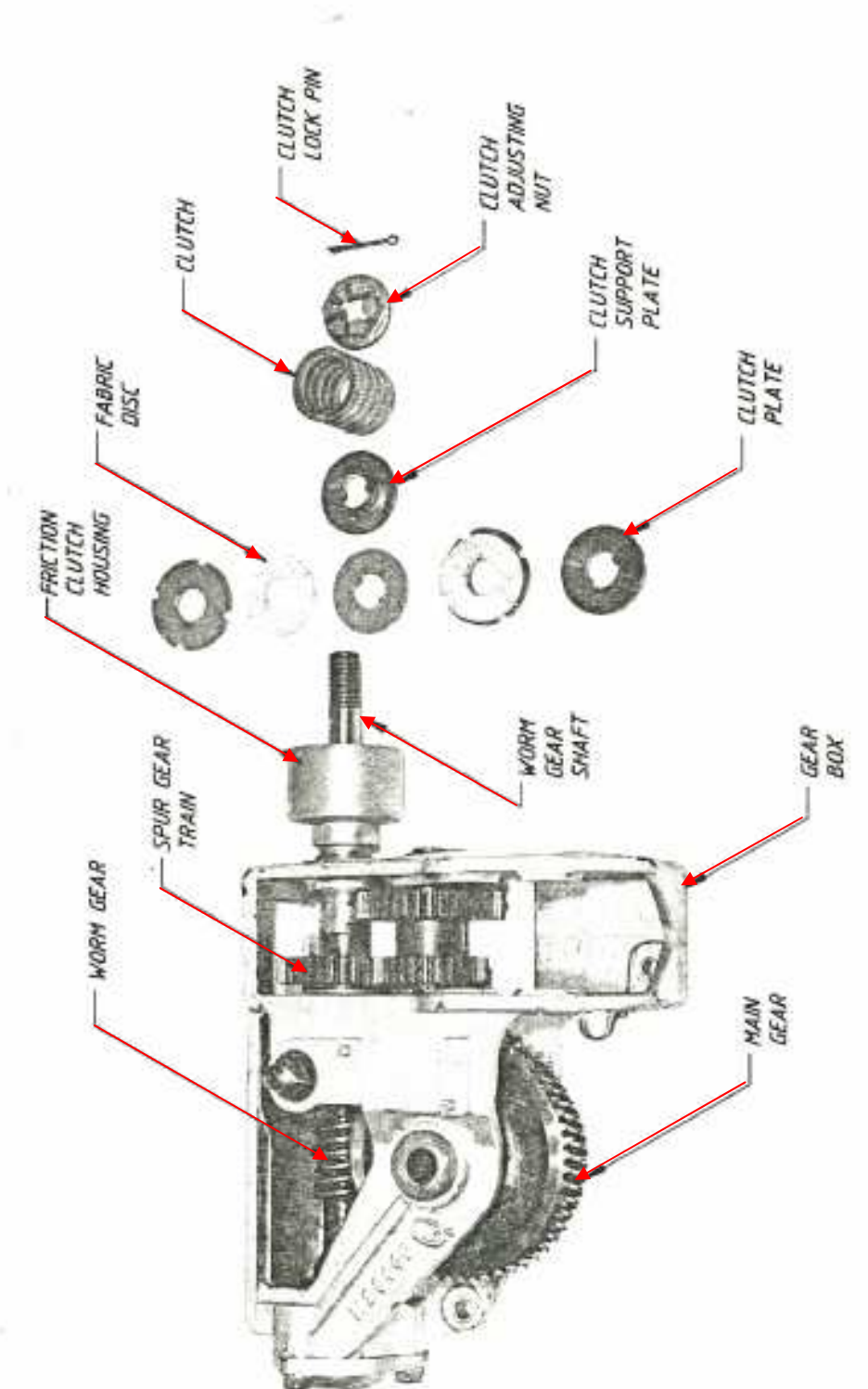


Figure 4.2.1

Gear Train Assembly

4.2 Gear Train and Clutch Assembly

4.2.1 Description

The motor drives a spur gear train, which in turn drives a worm through a friction clutch. The worm engages the main gear, which drives the lock and throw mechanism. The clutch protects the mechanism from shock at the end of the movement and also when the points are obstructed. The worm shaft is also engaged by a bevel gear driven by a shaft, which engages the manual crank handle.

4.2.2 Adjustment of Friction Clutch

Before leaving the manufacturer, the friction clutch is adjusted for greater than average point loads. This adjustment should adequately allow any high point loads, which may be encountered during the machine's operation. However the clutch must be tested on completion of installation.

Re-adjustment may be necessary during the maintenance visit and conducted in the following manner.

To Test Clutch

1. Connect an ammeter in series with the motor circuit, and measure the normal operating current.
2. Insert a block of wood or similar between the switch and the stock rail so as to obstruct the operation of the switch.
3. Operate the switch machine, and measure the obstruction current. The clutch should slip at approximately 150% of the normal operating current.

To Adjust Clutch

1. Remove supply from the motor by removing circuit fuses.
2. Remove split pin from clutch adjusting nut.
3. Tighten clutch adjusting nut, replace split pin and re-test. Repeat items 1-3 as required until the correct adjustment is achieved.

NOTE: Clutch slippage may be caused by worn clutch discs or by fouling of the clutch discs with lubricant from the gear train due to ineffective packing between the clutch shaft and housing (see Section 4.2.3).

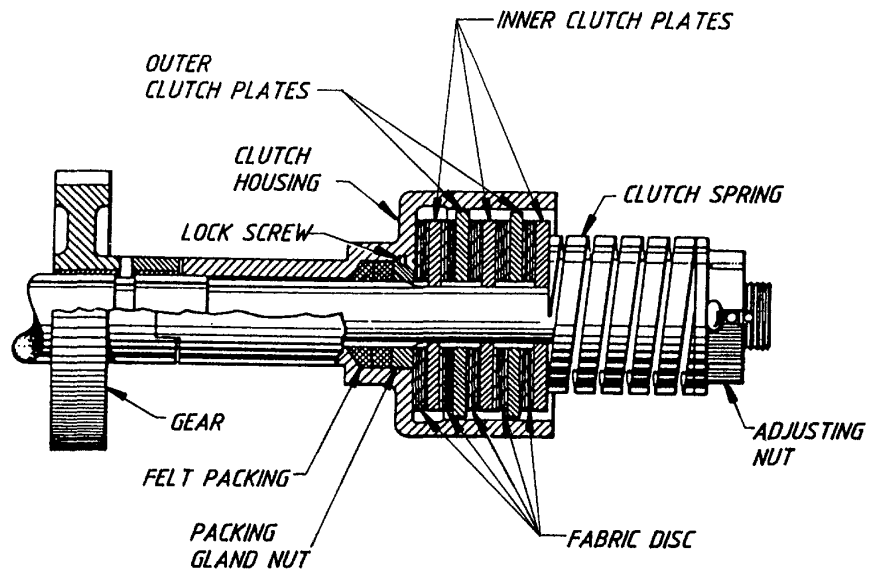


Figure 4.2.3.1

Cross -Section of Friction Clutch

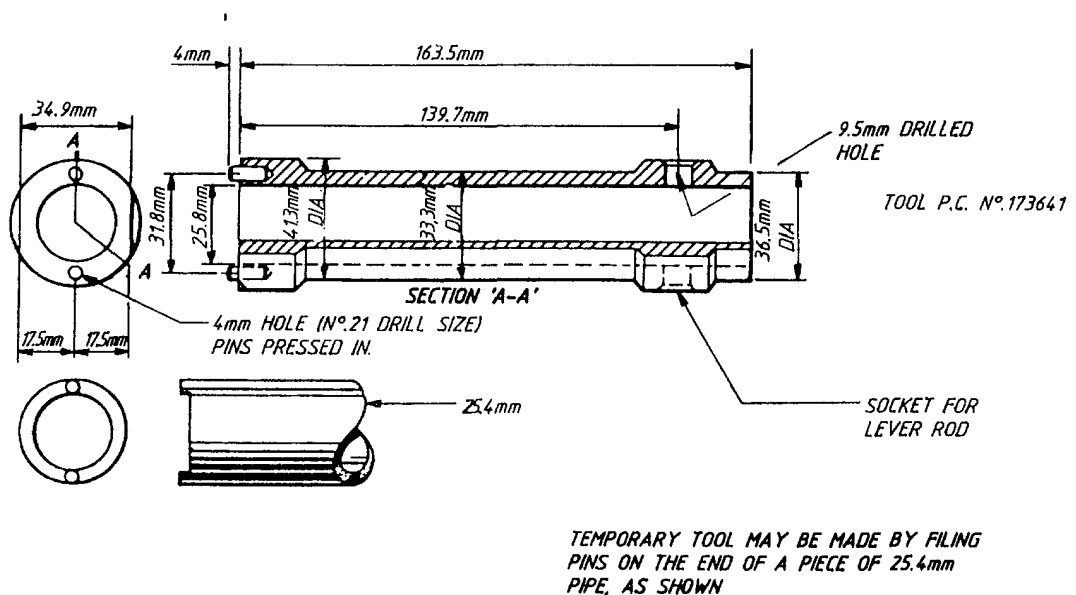


Figure 4.2.3.2

Special Tool

4.2.3 Overhaul of Clutch

The cross-section of the friction clutch is shown in Figure 4.2.3.1. Overhaul of the clutch should be carried out as follows:

1. Measure length of clutch spring before dis-assembling and note this dimension.
2. Remove adjusting nut and clutch spring and slide clutch housing off shaft. Remove discs and plates, take out small lock screw and use special tool (Figure 4.2.3.2) to remove packing gland nut.
3. Remove old felt packing and clean shaft and inside of clutch housing by washing with chlorothene. After parts are thoroughly cleaned and dried, a light coating of lubricant should be applied to shaft at point where new packing is to be applied.
4. Assemble clutch housing on shaft with end of clutch housing meshed in hub of gear. One new felt packing, should be slipped over the shaft and tamped securely into the packing gland with the plain end of the special tool. After first packing has been assembled. A second felt packing should be inserted in same manner and tamped down.
5. Insert the packing gland nut and tighten using the spanner end of special wrench until it is flush with bottom of clutch housing. Insert lock screw and tighten securely.
6. Clutch plates and fabric discs should be thoroughly cleaned with chlorothene to remove any accumulation of lubricant, inspected for damage and wear and replaced if necessary prior to reassembly in the order shown in Figure 4.2.3.1. It will be noted that a fabric disc goes in the bottom of the housing and the first metallic disc is one with teeth engaging the shaft. The remaining discs and plates assemble in the order shown.
7. The clutch spring should be adjusted to its original length and finally checked and adjusted to the correct slip current in accordance with Section 4.2.2.

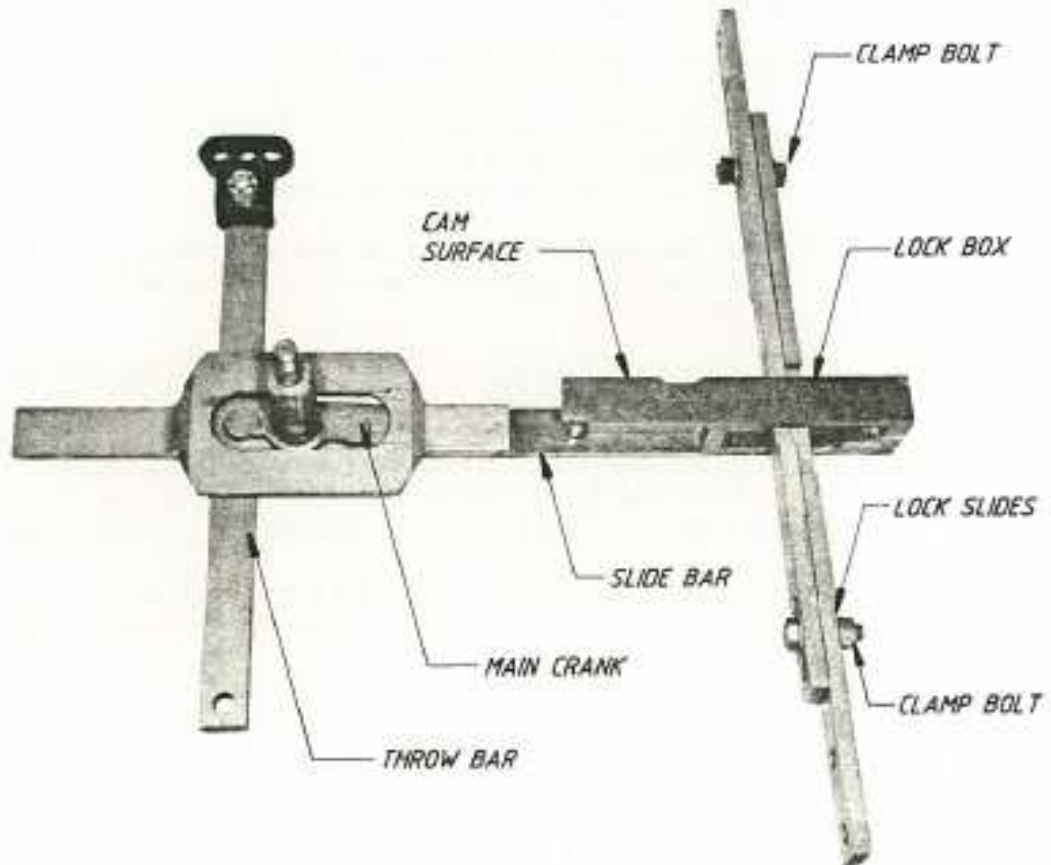


Figure 4.3.1

Point's Throw and Lock Mechanism

4.3 Points Throw and Lock Mechanism

4.3.1 Description

The points throw and lock mechanism, Figure 4.3.1, consists of the slide bar, the throw bar, the main crank, the lock box and lock slides. The main crank, driven by the gear train, operates the throw and slide bars to throw and lock the points. The position of the switch points is checked and secured by the lock box, which rests on and is operated by an extension of the slide bar. The lock box and lock slides are so arranged that the point machine may be installed on the right or left of the points without internal changes to the machine.

4.3.2 Adjustment of Lock Slides

Adjustment should be conducted under manual operation (Section 4.e).

1. Throw points to close switch adjacent to the point machine.
2. Loosen clamp bolts.
3. Adjust rod connection so that locking dog in lock box engages notch in lock slide and in doing so, holds point blade against stock rail.
4. Wind the points to close the opposite switch.
5. Move the second lock slide into correct position so that the other locking dog in the lock box engages notch in lock slide. Engage serrations and tighten bolts clamping slides together at each end.
6. Test adjustments in the following manner:
 - (a) Insert a 1.6mm (1/16") gauge between the point of the switch and stock rail. The lock should be adjusted such that locking is completed.
 - (b) Insert a 3.2mm (1/8") gauge between the point of the switch and the stock rail. The lock should be adjusted so that locking cannot be completed. Re-adjust if necessary and repeat step (a).

Note: The locking action may be observed through holes in the casting covering the lock box. When adjusting the slide with the notch on the bottom, marks made on top edge are used as a guide.

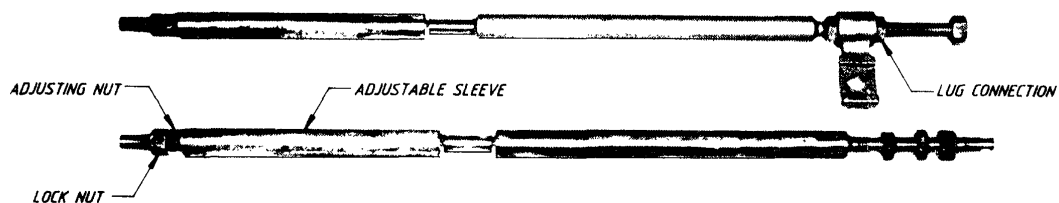


Figure 4.4.1.1

Detector Rods

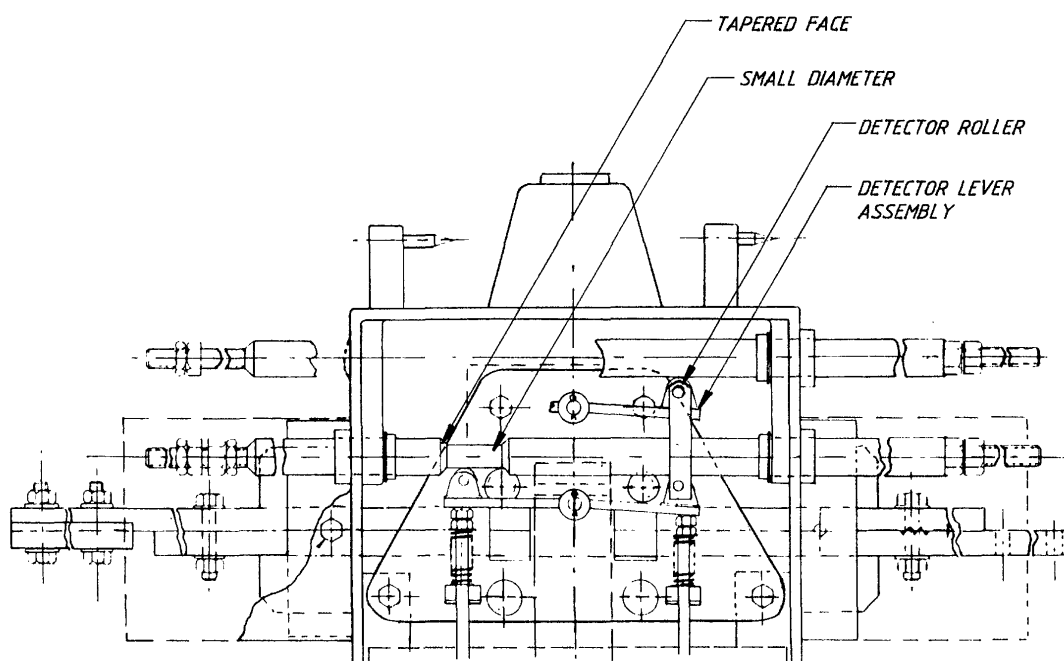


Figure 4.4.1.2

Point Detector Assembly

4.4 Point Detector

4.4.1 Description

The point detector assembly, shown in Figure 4.4.1.2, consists of rod shaped detector slides, Figure 4.4.1.1, which mechanically determine the position of the switches. The mechanical movement is transferred through a detector lever assembly to open and close the required contacts on the circuit controller.

4.4.2 Adjustment of Detector Slides

(Refer to Figures 4.4.1.1 and 4.4.1.2).

1. Crank machine to close switch furthest from the machine.
2. Adjust connecting rod of detector slide connected to the closed switch so that the detector roller, in contact with this detector slide and nearest to the points, is just touching the small diameter and tapered face of the detector rod.
3. Adjust connecting rod of detector slide connected to the open switch so that the roller, in contact with this detector slide and nearest to the points, is resting in the small diameter and about 3 mm clear of the tapered face.
4. Crank machine to close switch nearest machine.
5. Adjust sleeve of detector rod connected to the open switch so that the detector roller, in contact with this slide and furthest from the points is resting in the small diameter and approximately 3 mm clear of the tapered face.
6. Adjust sleeve of detector slide connected to the closed switch so that the detector roller, in contact with this slide and furthest from the points is just touching both the small diameter and tapered face.
7. Check the adjustment by using a 3.2mm (1 /8") facing point gauge to check that the contacts are just made at 3.2mm switch opening.

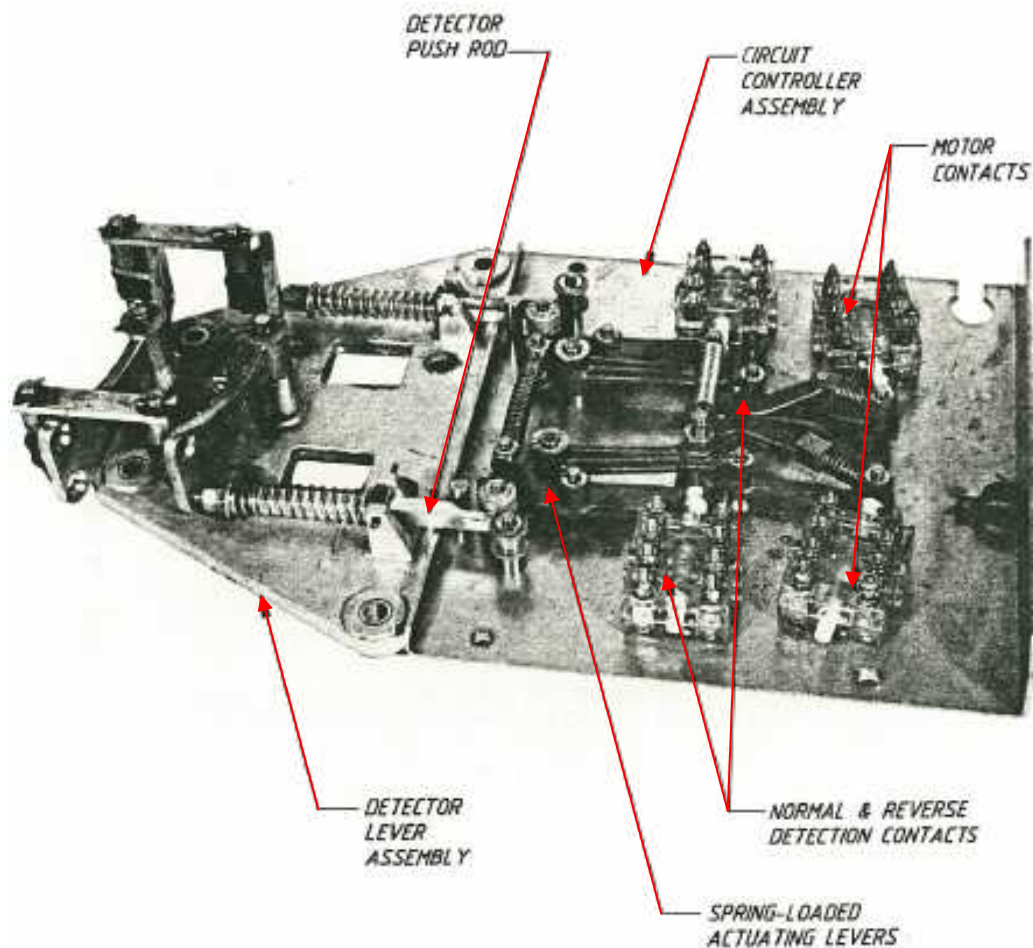


Figure 4.5.1

Circuit Controller

4.5 Circuit Controller

4.5.1 Description

The circuit controller shown in Figure 4.5.1, comprises of two sets of sealed contacts for the points detector and two sets of snap action motor contacts.

The detector contacts are operated by both a roller, which follows the cam surface cut into the lock box above which the circuit controller is mounted, and the detector lever assembly, which operates through a roller, and lever assembly. The detector lever assembly overrides the lock box roller to ensure that detection is dependent on the position of both the lock box and the switch blades, proving that the points are in the correct position and locked.

The motor control switches (one for each direction of operation) are operated by the lock box roller through a toggle mechanism, which gives a snap action. As soon as the motor circuit is cut, the switch applies a "snub" to the motor, which stops it abruptly, thus avoiding impact at the end of the traverse.

4.5.2 Adjustment of Detector Push Rods

When a detector roller is touching the bottom of its recess, the associated push-rod should allow the detector switch roller (at the far end of the push-rod) to rest clear (10.4 mm max) of the 45 degree step in the rod. Adjustment of this clearance is by means of the hexagon domed nut and lock nut on the threaded end of the push-rod.

4.6 Point Contactor

4.6.1 Description

The point contactor, shown in Figure 4.6.1, is a plug-connected interlocked 50 volt D.C. magnetic stick relay which actuates 3 sets of normal and 3 sets of reverse contacts. The point contactor determines the direction of the motor by switching to the appropriate field winding. To protect the contacts from foreign matter which may disrupt operation, the unit is sealed by a protective plastic cover.

4.6.2 Removal

The point contactor is simply removed by unplugging the lead and loosening the two screws at the base.

4.7 Motor Protection Unit and Rectifier

4.7.1 Description

The motor protection unit, shown in Figure 4.7.1, is located on the mounting plate of the terminal board. It is designed to protect the motor and the friction clutch in the event that an obstruction prevents movement of the throw mechanism by cutting the motor circuit when operation takes abnormally long. The motor circuit is reconnected automatically by restoring the points lever to its original position.

4.7.2 Rectifier

A bridge rectifier is fitted next to the motor protection unit, as shown in Figure 4.7.1, to convert the incoming A.G. supply current to D.C. operating current.

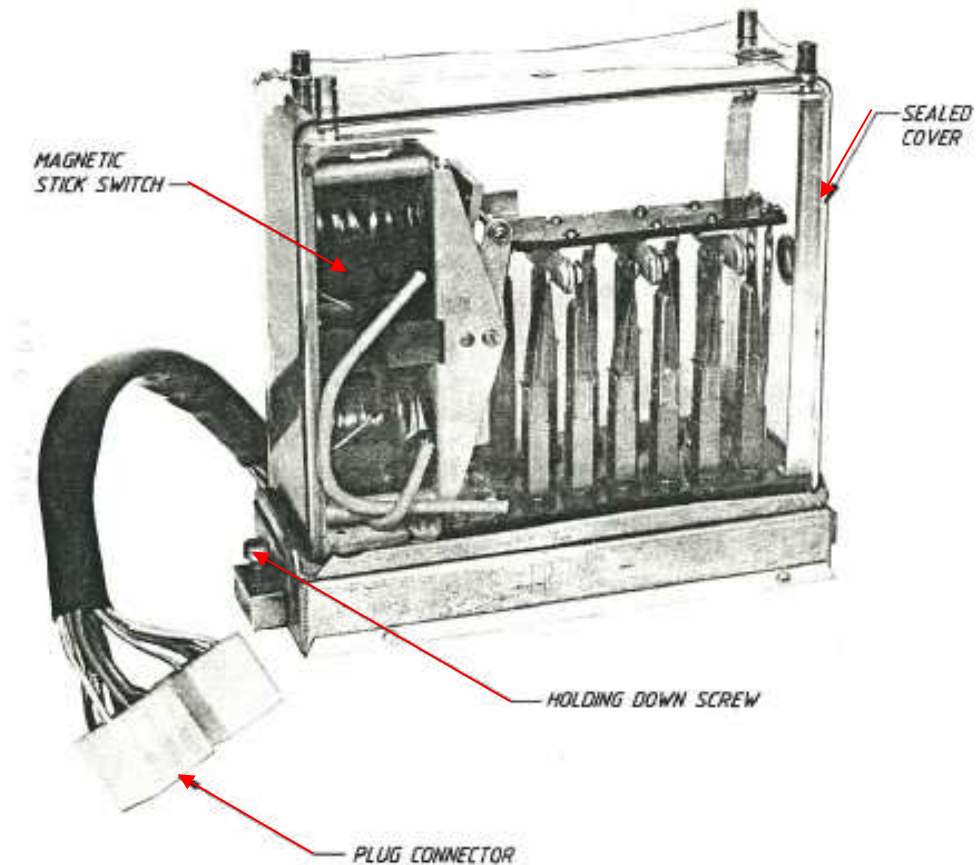


Figure 4.6.1

Point Contactor

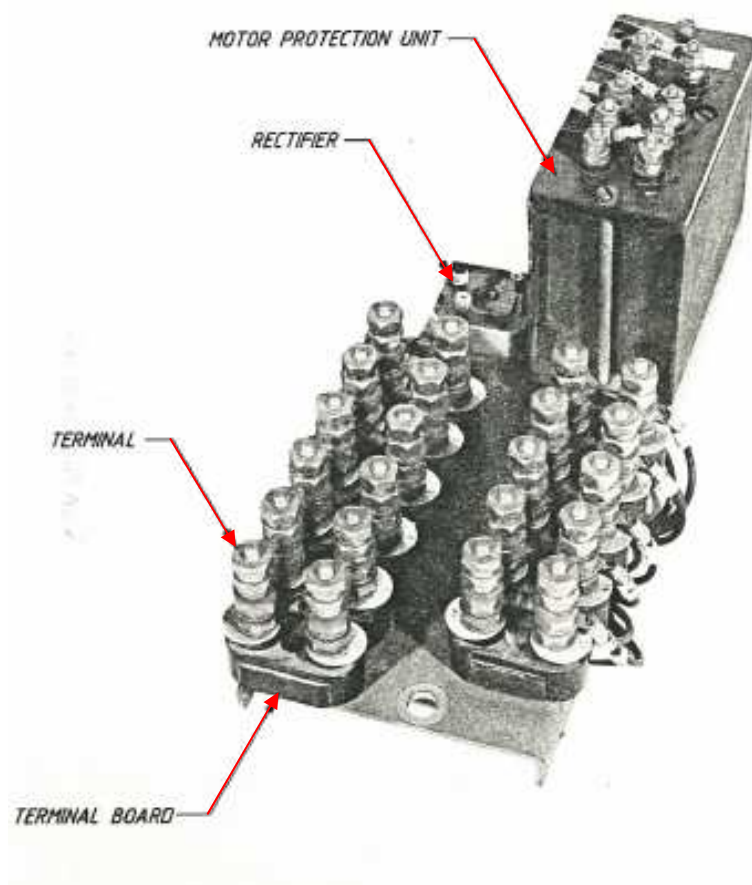


Figure 4.7.1

Terminal Board, Motor Protection Unit and Rectifier

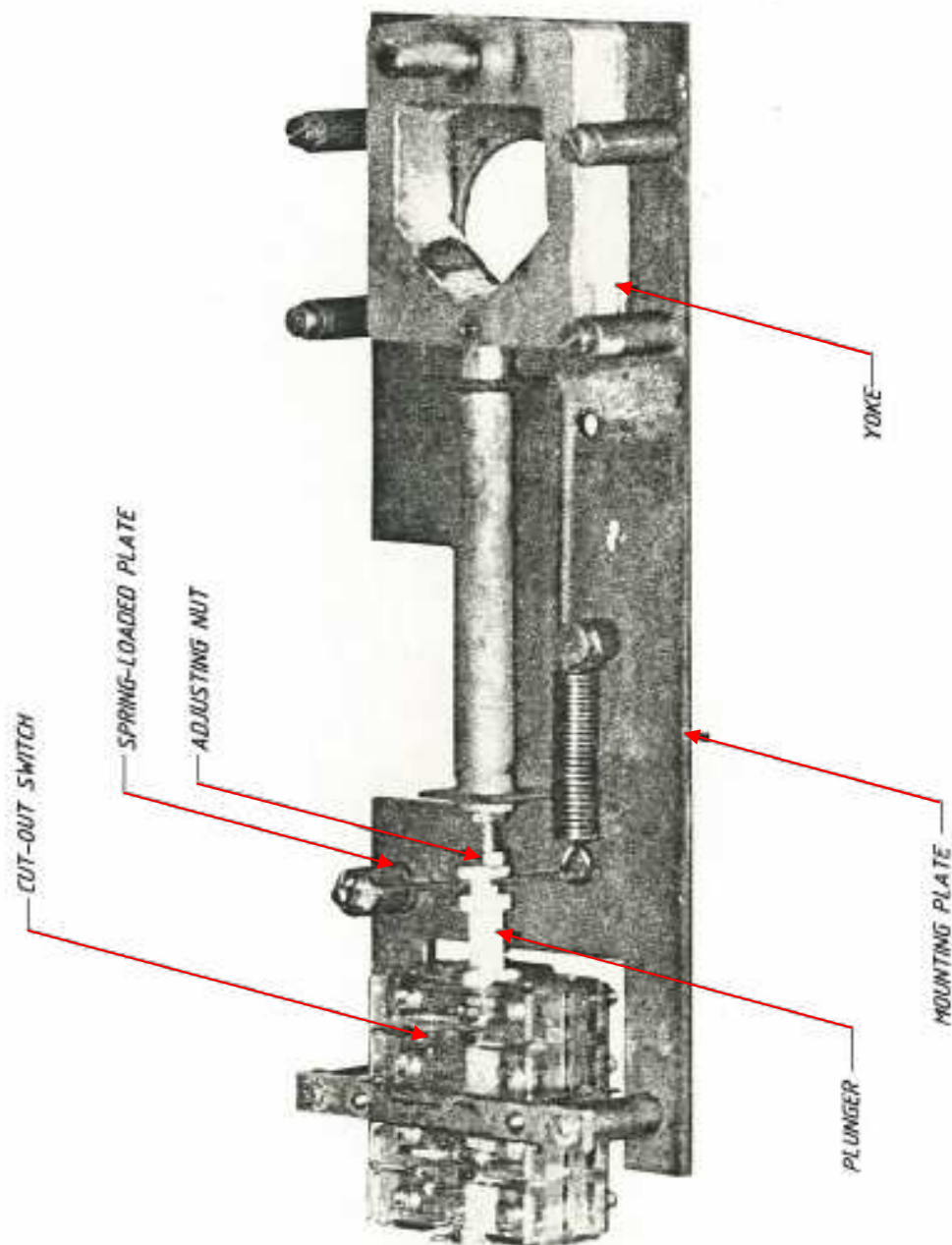


Figure 4.8.1

Cut-Out Switch Assembly

4.8 Manual Cranking Device

4.8.1 Description

Manual operation is obtained by inserting a crank handle through a separately covered hole in the cover of the machine. Opening of the cap on the cover reveals the yoke of the cut-out mechanism, shown in Figure 4.8.1. Pushing the yoke across allows the crank handle to be inserted onto the cut-out spindle and simultaneously opens the cut-out switch through an extended shaft to disconnect the motor. Removal of the crank handle re-closes the cut-out switch and restores the motor circuit.

4.8.2 Adjustment of Cut-Out Switch

Adjustment is achieved by the adjusting bolt as shown in Figure 4.8.1. The bolt should be adjusted so that it just touches the plunger of the cut-out switch when the yoke is in its normal position.

5 Maintenance Procedures

5.1 General

Before commencing, notify the signaller and carry out normal safeworking procedures. All PPE applying to personnel working on or near the track must be observed. Whenever possible the maintenance activities of the Signal Electrician and the Signal Sectionman should be performed simultaneously.

5.2 Tools

Description	Size	Quantity
BACHO adjustable spanner	18" (450mm)	2
BACHO adjustable spanner	15" (375mm)	2
BACHO adjustable spanner	12" (300mm)	2
Screwdriver	8" (200mm)	1
Chisel (cold)	1	
Podger (claw type)	1	
F.P.L. gauge	1/8" (3.2mm)	1
F.P.L. gauge	1/16" (1.6mm)	1
Whitworth, A.F. and metric socket sets with drive extension and ratchet	1 set 1 set	
Whitworth, A.F. and metric ring spanners		
Relay spanner	1	
Crank handle	1	
Vernier Calipers	1	
Special tool for clutch overhaul	1	

Check also that the kit includes consumables such as chamois leather, cotton waste, emery cloth, and lubricants.

5.3 Check that Point Machine is Secure

Holding down bolts should be checked for security and tightness. Check for lost motion in switch connections, point slides, lock slides and detector rods.

5.4 Examine Track Conditions at Switch Location

Examine track in respect to ballast condition and rail movement at switch heel, fit of switch to stock rail, condition of chairs, bolts and spikes. If lateral or longitudinal movement is detected, notify the civil maintainer for rectification.

5.5 Adjust Facing Point Locks (F.P.L.)

Facing point locks must be tested to ensure that the switches are kept tight against the running face of the stock rail, and to ascertain if "A" chairs or stock rails are worn. The following steps should be conducted under manual operation:

- (i) Adjust lock slides in accordance with procedures outlined in Section 4.3.2.
- (ii) Test adjustments in the following manner:
 - (a) Insert a 1.6mm (1/16") gauge between the point of the switch and stock rail. The lock should be adjusted such that locking is completed.
 - (b) Insert a 3.2mm (1/8") gauge between the point of the switch and the stock rail. The lock should be adjusted so that locking cannot be completed. Re-adjust if necessary and repeat step (a).

5.6 Adjust Detector Slides

Adjust detector slides in accordance with procedures outlined in Section 4.4.2. and ensure that contacts are just made with the 3.2mm gauge inserted between switch and stock rail.

5.7 Check Switch Travel

Ensure that travel at the point of the switch is correct at 115mm.

5.8 Motor Maintenance

The motor is equipped with sealed ball bearings which eliminates the need for lubrication. The operation of the motor should be observed at each maintenance visit. If it shows signs of abnormal noise, slackness in the bearings or heavy burning of the commutator, the motor should be exchanged and forwarded to the workshops for over haul. If the motor is operating properly, the only maintenance required is as follows:

- a) Check the wear on the brushes and replace them if necessary. Do NOT interchange the brushes. Brushes should not be removed unless absolutely necessary. If they are removed, care should be taken to ensure that brushes are replaced in the same positions as they were in prior to removal.
- b) If the commutator has a polished bronze or coffee-coloured finish leave untouched. Otherwise clean carbon dust off the commutator and brushes and clean the commutator with a chamois. Do not use emery paper to clean the commutator. If commutator is burnt, clean with fine glass paper and polish with a chamois.
- c) Check that the brushes slide freely in their holders.
- d) Check by observing the motor in operation that the brushes are seating over the full width. (Poor seating is evidenced by uneven arcing.) If they are not, hold a

25mm x 150mm strip of emery cloth tightly around the commutator, face outwards and rotate against the brush in both directions until seating is improved.

5.9 Circuit Controller and Detector Contacts

Visually check the condition of all contacts and observe the operation of each contact assembly ensuring adequate wipe of the contacts as the machine is operated by hand. Replace any contact assemblies which have pitted or burnt contacts. Check the adjustment of the contact assembly push rod and adjust if necessary as in Section 4.5.2.

5.10 Point Contactor

The point contactor is a sealed unit and must be closely observed during operation and changed if contacts appear to be badly burnt or pitted.

5.11 Motor Protection Unit

Test the motor protection unit by obstructing points with a wood block or similar and ensure that the motor is cut off in approximately 10 seconds. If it is less than 7 seconds temporarily wire the unit out of circuit and replace as soon as practical.

5.12 Draining

During each maintenance visit, remove the 9.5mm B.S.P. drain plug (located in the crankcase cover under the machine) for draining the machine, particularly if freezing is likely.

5.13 Adjust Clutch

Check and adjust the clutch in accordance with procedures outlined in Section 4.2.2.

5.14 Clean Point Machine

Clean all excess oil and foreign matter from the machine, particularly the slides.

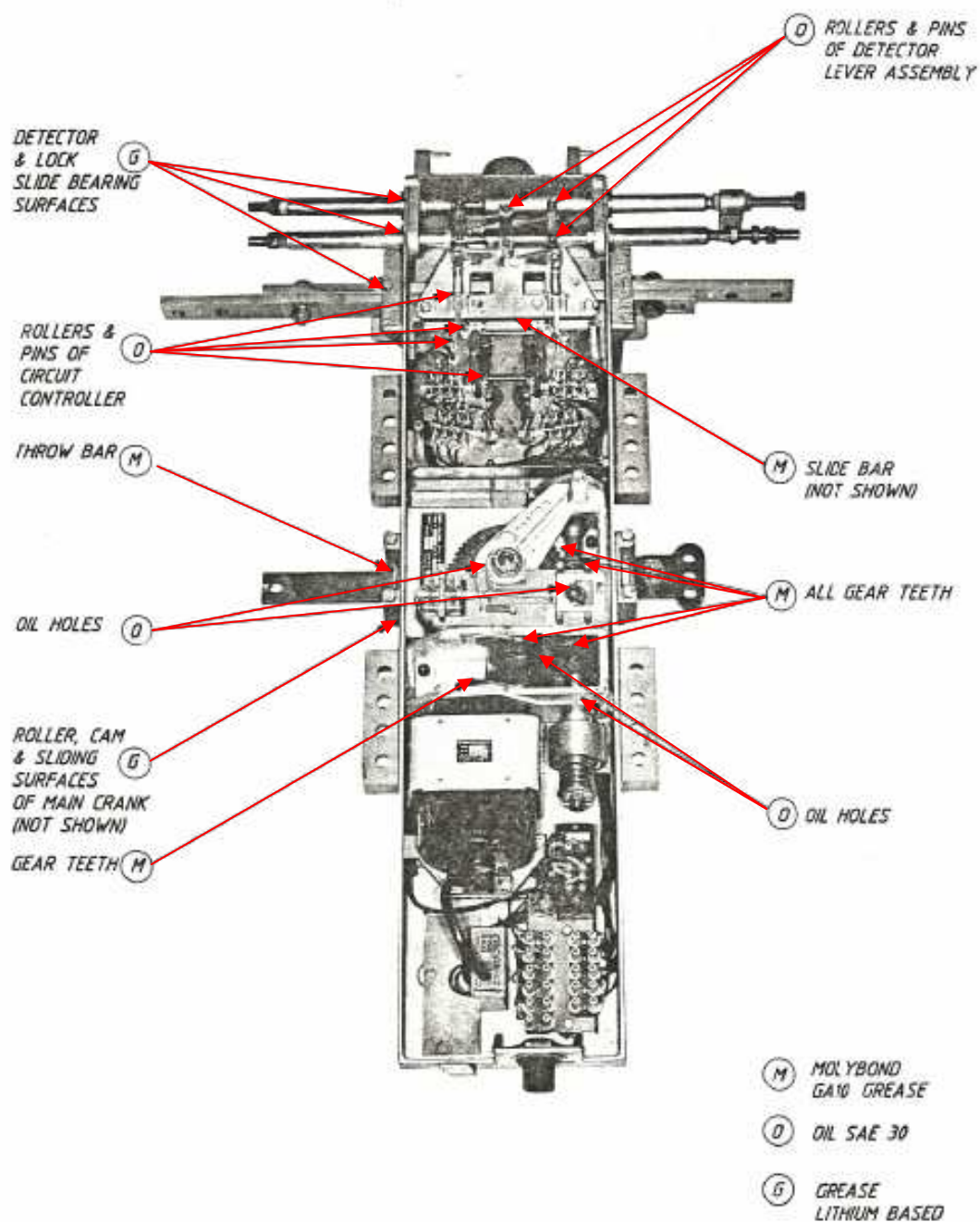


Figure 5.15

Lubrication Diagram

5.15 Lubrication

Remove the covers to the machine and lubricate all moving parts as indicated on the Lubrication Diagram 5.15 and with lubricants specified in Table 5.15.

Table 5.15 Lubrication

Parts	Lubricants	Remarks
Small pins and sliding parts marked "O".	Oil SAE – 30	Clean the parts well before applying. Surplus oil should be wiped off as it attracts dust
Medium and heavy load bearings marked "G"	Grease, multi-purpose Lithium Based, M1 26843151	Use a grease gun for lubrication
Sliding surfaces detector, lock slides and throw bar, gear teeth marked "M"	Molybond GA10 Grease	Apply sparingly by brush after cleaning off build up

Points to be observed while carrying out lubrication:

1. Use only the recommended grade of oil. Inferior grades should be avoided as they may cause rust, material fatigue or blockage in oil holes.
2. On locations of light pin movement, only a few drops of oil are required.
3. Use brushes to grease gear surface where heavy weight is applied.
4. Supply a thin layer of oil on all sliding surfaces and at times wipe with an oil cloth to remove accumulated grit.
5. The slide chairs must be cleaned and lubricated with an approved dry lubricant at each maintenance visit by the maintainer.

5.16 Excess Ballast

Clear all ballast and foreign matter likely to foul the operation of the point machine to ensure clearance around all moving parts of the points.

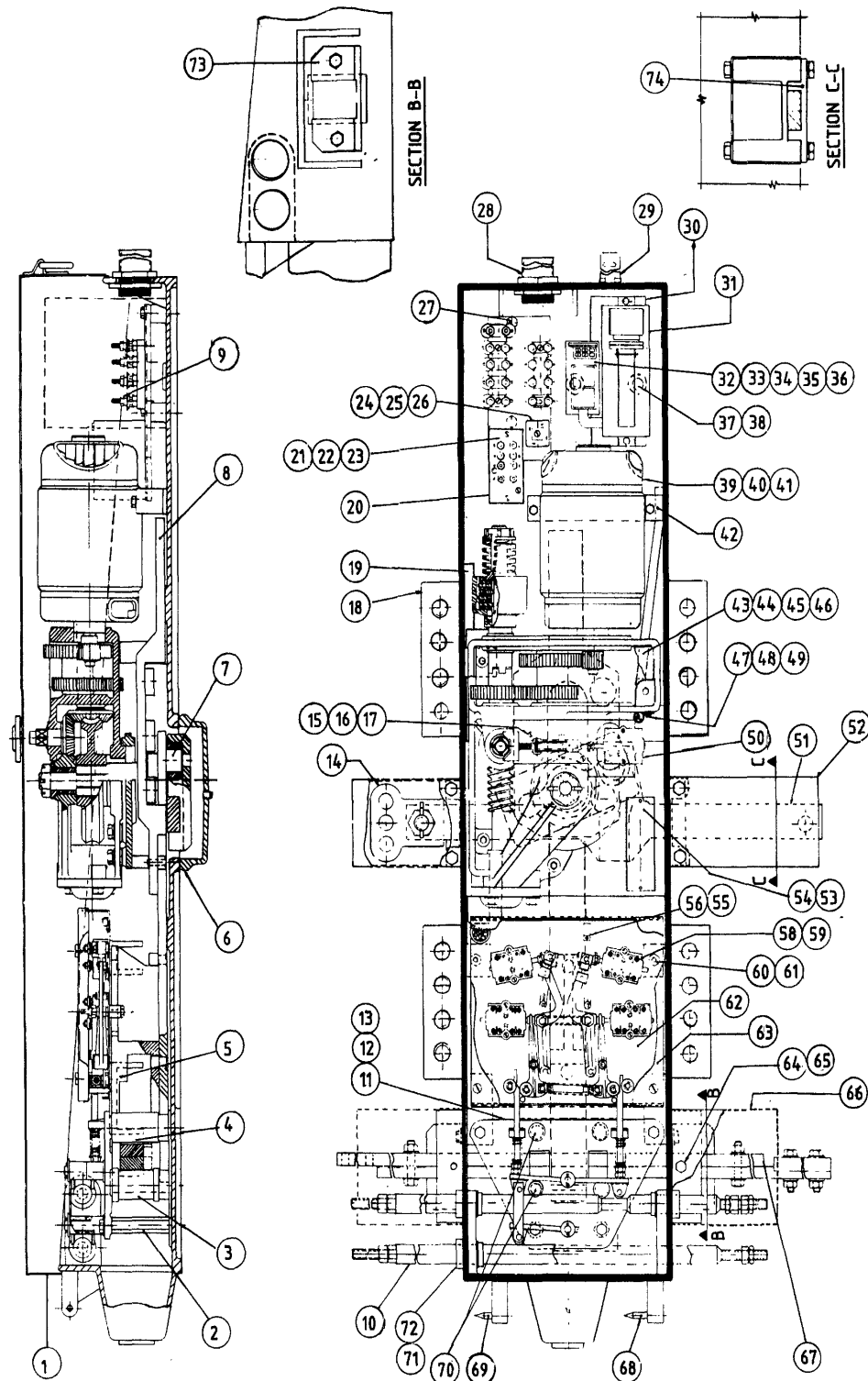
5.17 Check Operation of Point Machine

Check smoothness and correctness of operation by switching several times using manual operation, and finally by power operation.

5.18 Overhaul

A fixed overhaul period cannot be set due to traffic movement frequencies and local conditions. Overhaul periods must be determined by inspection during maintenance, to determine the amount of wear on the gears, throw bar, lock slide bearing surfaces and the general condition of the mechanism. General overhaul involves complete stripping, cleaning and inspection, replacement of worn and faulty parts and reassembly as discussed in appropriate sections of this manual.

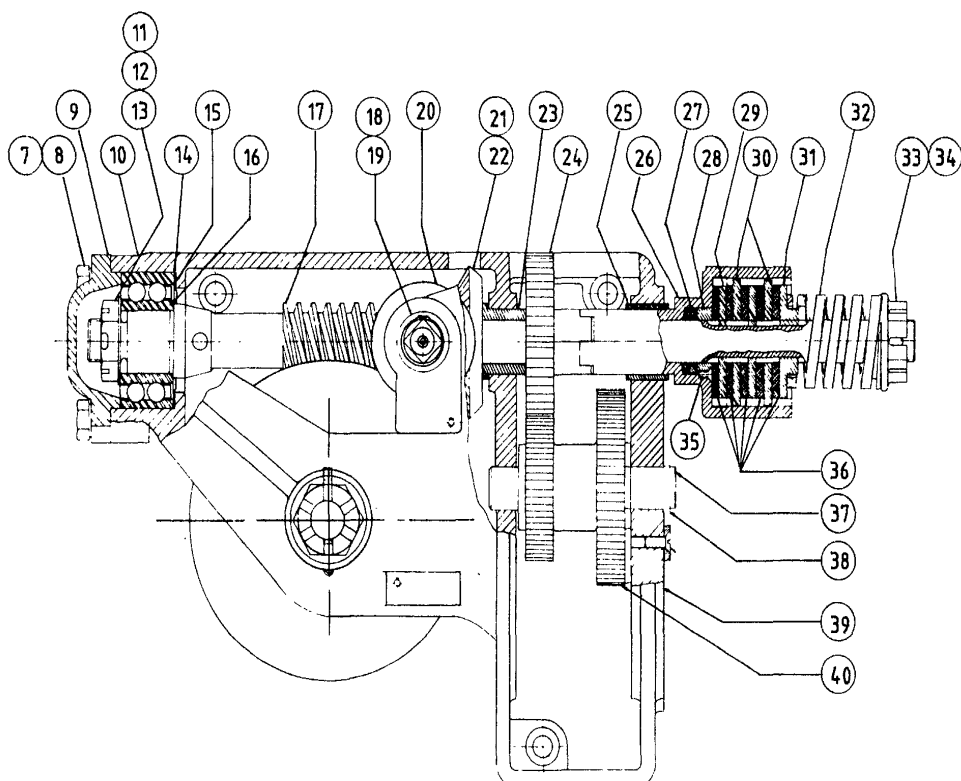
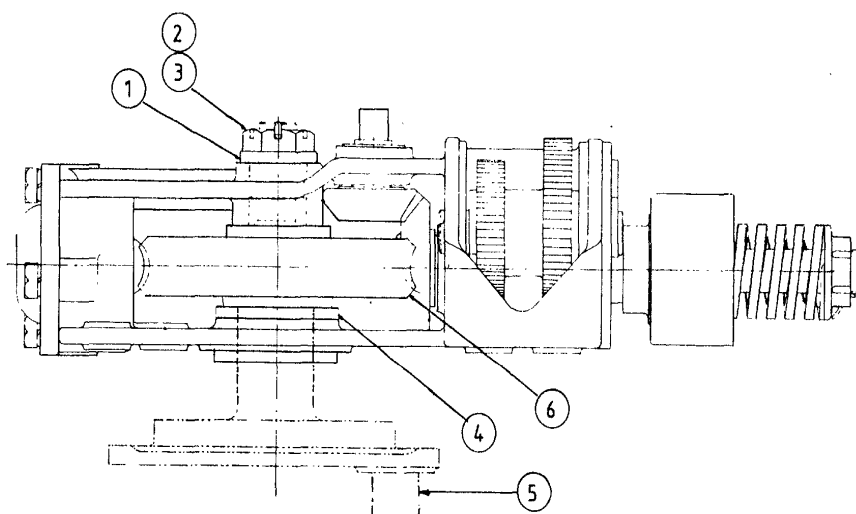
6 Parts List and Drawings



6.1 Electric Point Machine Complete, 'M70' MKIII

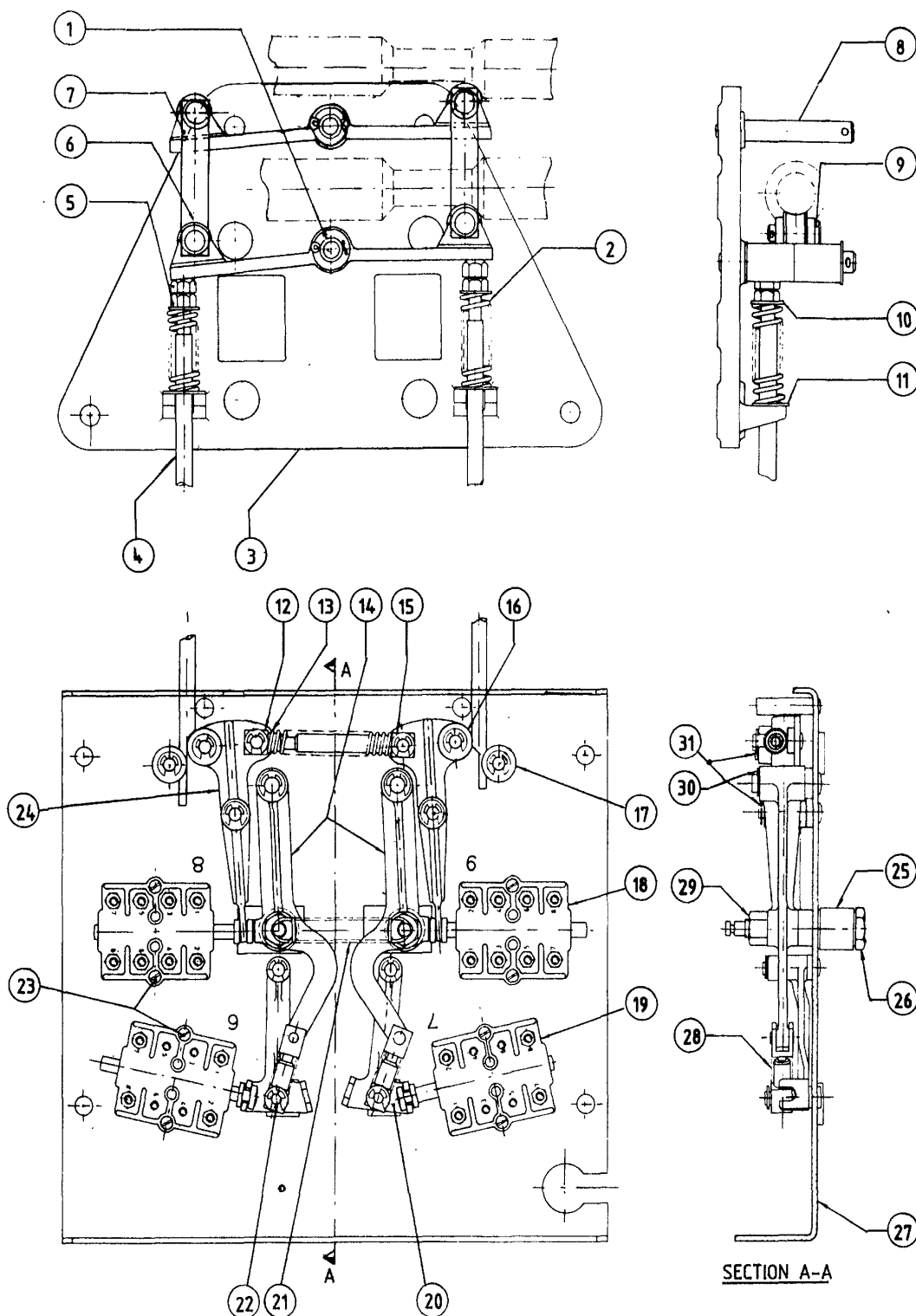
Item No.	Item Description	Manufacturer's Part No.	M.I. No.
1	Cover, Complete	M20750	
2	Stud	M20461	
3	Roller — 2 in. Dia.	M7624	
4	Roller — 1 3/4 in. Dia.	M7625	
5	Lock Box	CM267-27/2	
6	Cover — Crankcase	146290	
7	Crank — Main	71158	
8	Bar — Slide with connector	146444	
9	Block — Terminal, 4 Way	181829	
10	Detector Slide, Complete		
11	Detector Lever Assembly (Double)	M23930	
12	Bolt, 3/8 in. B.S.W. x 1 1/4 in Lg. Hex. Hd. Steel Tin Plate	M6800	
13	Hood, Lock Slide	M20548	
14	Lug, Throw Bar	146443	
15	Washer, Spring 3/16 in. Tin Plate	4024/10	
16	Screw, 2BA x 3/8 in. Lg. Ch. Hd. Steel, Tin Plate	M2103	
17	Washer, Plain 3/16 in.	4023/14	
18	Base	M20484	
19	Tube, Insulating	AM4811-33/2	
20	Terminal, Chassis. Cu. Tin Plate	BM510-54/1	
21	Motor Protection Unit — 50 V dc	M23832	
22	Nut Nyloc. 2BA Steel	4254/30	
23	Washer, 2BA, Plain, Brass, Tin Plate	17376	
24	Rectifier, S10 PFA	4940/10	
25	Washer, Spring, 3/16 in. Tin Plate	4024/10	
26	Screw, 2BA x 3/8 in. 1g. Ch. Hd.y Steel, Tin Plate	M2103	
27	Screw, 3/8 in. BSW x 3/4 in. Lg. Hex. Hd. Steel, Tin Plate	4166/23	
28	Conduit, outlet 'ELMACO' , 'ELMACO Cat. No. 161'	4467/137	
29	Hasp and Staple, Safety Type 6 1/2 in. 'McPHERSONS Cat. No. F1607'	4742/15	
30	Bracket, Contactor Mounting, AC Immune	M23471	
31	Contactor, Complete, 50Vdc	M23856	
32	Clip, Spring	AM3879-59/1	
33	Tab. Housing 'AMP No. 480171-1'	4036/87	
34	Receptacle	4036/176	
35	Screw, 4BA x 1/4 in. Lg. Ch. Hd. Steel, Tin Plate	M2328	
36	Rivet, Pop. 1/8 in.	4745/0	
37	Washer, Star, 3/8 in.	4025/0	
38	Screw, 3/8 in., UNC X 3/4 in. Lg. Hex. Hd. Steel, Tin Plate	4166/52	
39	Motor, Complete, 110 Vdc Series Wound	M23805	
40	Bolt, 3/8 in. BSW x 2 ins. Lg. Hex. Hd.		

Item No.	Item Description	Manufacturer's Part No.	M.I. No.
	Steel, Tin Plate	M6797	
41	Washer, Spring, 3/8 in. Cad. Plate	4024/16	
42	Washer, Special	AM1780-89/1	
43	Gear Box Assembly, Complete	M23834	
44	Cover, Gear	M21879	
45	Washer, Spring 1/2 in., Tin Plate	4024/3	
46	Screw, 1/2 in. BSW x 1 1/2 in. Socket Hd., Steel, Tin Plate	4155/1	
47	Screw, 2BA x 3/8 in. Lg. Ch. Hd. Steel Tin Plate	M2101	
48	Washer, Spring 3/16 in., Tin Plate	4024/10	
49	Clip, Conduit, 3/4 in.	4407/78	
50	Cut-Out Switch Assembly, Complete	M23837	
51	Throw Bar	146441	
52	Hood — Throw Bar	148141	
53	Nameplate	AM4881-325/1	
54	Screw, Drive No. 4, Tin Plate	4091/11	
55	Clip, Cable, 'Plaskip No. 6'		
56	Washer, Plain, 4BA	4023/15	
57	Screw, 4BA x 1/4 in. Lg. Ch. Hd. Steel Tin Plate	M2328	
58	Nut, Nyloc, 2BA. Steel	4254/30	
59	Washer, 2BA Plain, Brass, Tin Plate	17376	
60	Bolt, Special	AM7598-43/1	
61	Washer, Spring 3/8 in. Cad. Plate	4024/16	
62	Circuit Controller, Complete	M23835	
63	Cover, complete — Circuit Controller	M23840	
64	Washer, Spring, 3/8 in. Cad. Plate	4024/16	
65	Screw, 3/8 in. B.S.W. x 1/2 Lg. Hex. Hd. Steel, Cad. Plate	4166/25	
66	Hood, Lock Slide	M20548	
67	Lock Slide, Complete	M21103	
68	Pin-Hinge, Long	M21097	
69	Pin-Hinge, Short	M21368	
70	Stud		
71	Circlip, 'TRUARC Ref. No. 5100-162'	4484/93	
72	Bush	AM426-117/1	
73	Bracket — Support, Lock Rod	M16969	
74	Bracket — Wearing	189024	



6.2 Gear Box Assembly, Complete

Item No.	Item Description	Manufacturer's Part No.	M.I. No.
1	Bush, Upper — Main Crank	74741	
2	Nut, 1 in. BSW Hex. Slotted	74742	
3	Pin, Split Cotter 3/16 in. Dia x 1 5/8 in. Lg. Tin Plate	7103	
4	Bush, Lower — Main Crank	M21110	
5	Main Crank	71158	
6	Worm Wheel	74805	
7	Screw, 1/2 in. BSW x 1 1/4 in. Hex. Steel, Tin Plate	4166/12	
8	Washer, Spring, 1/2 in. Tin Plate	4024/3	
9	Cover, Bearing	M21226	
10	Gearbox Steel	EM140-13/1	
11	Nut, 1 in. BSW Hex. Slotted	74742	
12	Pin, Split Cotter, 3/16 in. Dia x 1 5/8 in. Lg. Tin Plate	7103	
13	Washer, Plain, 1 in. Tin Plate	4022/2	
14	Seal, Milos, No. 6307JV	4944/5	
15	Shim	AM1780-73/1	
16	Ball Bearing, Ridged Type 1.378 in. I.D., 3.149 in. OD, 1,374 in Wide 'HOFFMAN No. 5307'	4405/4	
17	Shaft, Worm	146378	
18	Washer, Thrust	AM1780-86/1	
19	Circlip, External 4484/91		
20	Pinion, Bevel — Hand Crank	146374	
21	Key, Woodruff No. 9	4757/2	
22	Gear — Bevel — Hand Crank	146374	
23	Bush — Worm Shaft	M20879	
24	Gear, Clutch, Complete	147130	
25	Bush, Clutch Housing, 1 1/2 in. L.D., 1 3/4 in. O.D. x 1 1/8 in. Lg. 'SHOR LUBE PART No C4856-3'	4236/19	
26	Housing — Clutch	M21244	
27	Washer, Felt	209442	
28	Nut, Round, 1 5/8 in., SAE Fine	172739	
29	Disc, Clutch — Inner	146574	
30	Disc, Clutch — Outer	146573	
31	End Plate, Clutch	146575	
32	Spring — Coil Nut,	74731	
33	Special, Hex	75423	
34	Pin, Split Cotter, 3/16 in. Dia x 1 5/8 in. Lg. Tin Plate	M7103	
35	Screw, 3BA x 1/4 in.Lg. C'sk Hd. Steel Tin Plate	M2184	
36	Disc, Clutch — Liner	146650	
37	Shaft	146627	
38	Lockplate	M20886	
39	Screw, 5/16 in. C'sk Hd. Steel, Tin Plate	4179/43	
40	Gear, Transmission, Complete	146569	

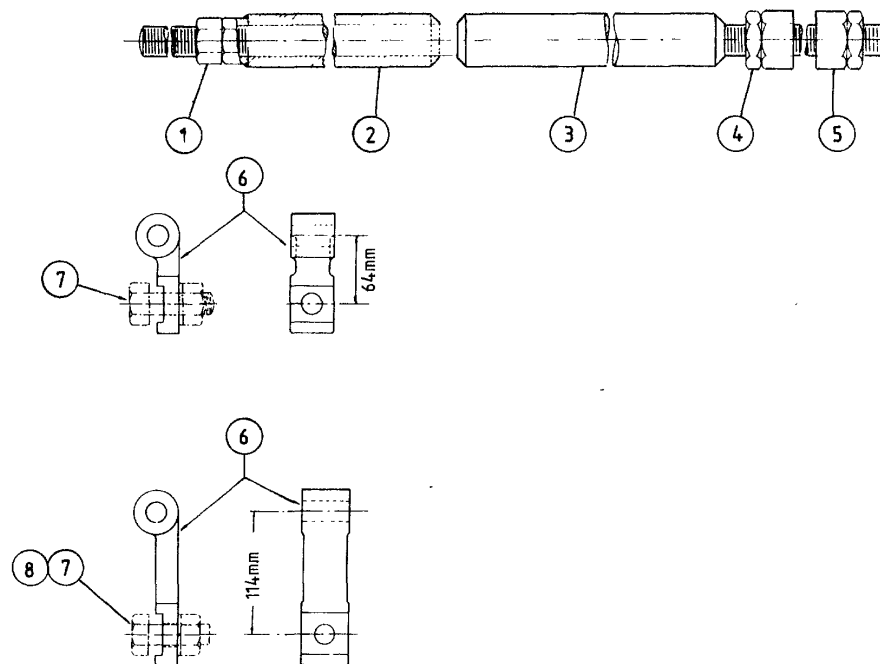


6.3 Circuit Controller and Detector Lever Assembly, Complete

Item No.	Item Description	Manufacturer's Part No.	M.I. No.
1	Washer, 7/16 in. Dia., Tin Plate	4023/6	
2	Spring, Coil	M20535	
3	Cover Plate, Lock Box	M20446	
4	Push Rod	AM758-44/1	
5	Nut, Special 5/16 in., BSW, Hex.	74776	
6	Arm, Detector	M20507	
7	Link	M13108	
8	Pin 7/16 in. Dia	M20532	
9	Pin, 3/8 in. Dia	AM678-2/5	
10	Washer, 5/16 in. Dia., Tin Plate	4022/14	
11	Washer, Special, 1 in. dia x 7/16 in. sq. Tin Plate	AM1780-88/1	
12	Spring Guide, Male Detector	AM758-67/2	
13	Spring, Compression, Detector	AM3935-50/6	
14	Arm, Operating, Complete	M23848	
15	Spring Guide, Female Detector	AM758-68/2	
16	Roller, Detector Arm, Complete	AM758-66/2	
17	Roller Guide, Complete	AM758-65/2	
18	Switch, Complete — Detector	M23846	
19	Switch, Complete — Motor	M23847	
20	Lever, Toggle, Complete	M23849	
21	Spring, Operating Arm, Tension	AM3935-51/1	
22	Spring, Guide, Female, Complete	AM758-45/2	
23	Screw, 4BA x 1 1/8 in. Lg. Ch. Hd. Steel Tin Plate	M17596	
24	Arm, Detector, Complete with Bushes	AM758-63/3	
25	Roller, Complete	AM758-47/2	
26	Post, Roller	AM758-48/1	
27	Base Plate, Complete	M23845	
28	Spring, Compression, Toggle	AM3935-50/1	
29	Nut, 3/8 in. x 24 UNF. Hex. Steel Tin Plate	4254/56	
30	Circlip, External, 3/8 in 'TRUARC TYPE No. 5133-37'	44184/57	
31	Circlip, External 1/4 in. 'TRUARC TYPE No. 5133-25'	4484/90	

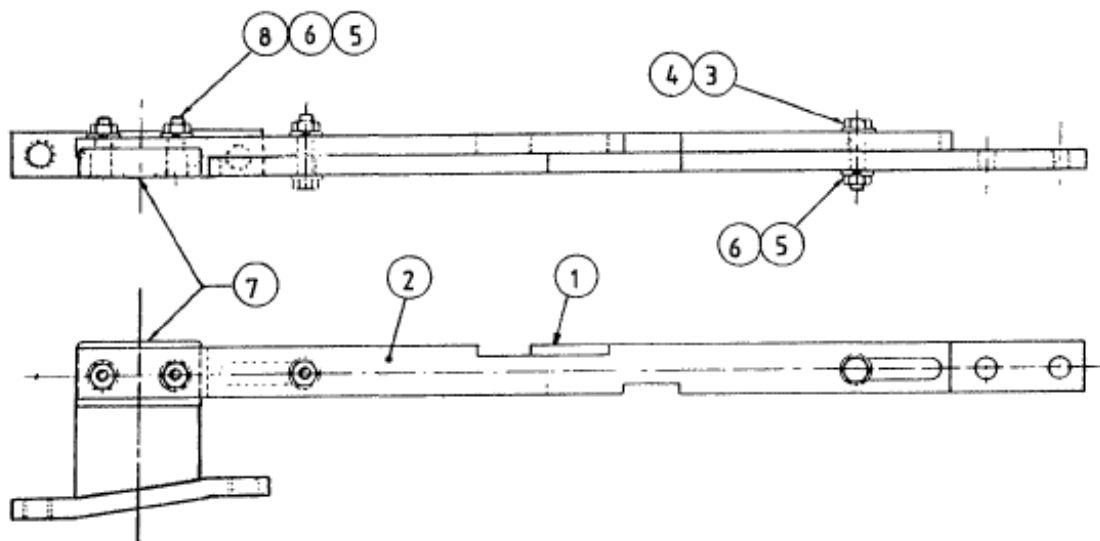
6.4 Detector Slide Assembly

Item No.	Item Description	Manufacturer's Part No.	M.I. No.
1	Nut Hex. $\frac{3}{4}$ in. BWS, Bright MS, Cad Plate	17854	
2	Sleeve, Complete	M8634	
3	Slide, Detector	M3542	
4	Locknut, $\frac{3}{4}$ in. BSW, STD. Hes., Black M.S., Cad. Plate	M6940	
5	Nut $\frac{3}{4}$ in. BSW, Hex., Black MS, Cad. Plate	M6928	
6	Lug, Drop-Short	M3544	
	Lug, Drop-Long	M18620	
7	Bolt and Nut, $\frac{3}{4}$ in. BSW x 2 $\frac{1}{2}$ in. Lg., Hex, Hd.	4150/14	
8	Washer, Spring, $\frac{3}{4}$ in.	4024/1	



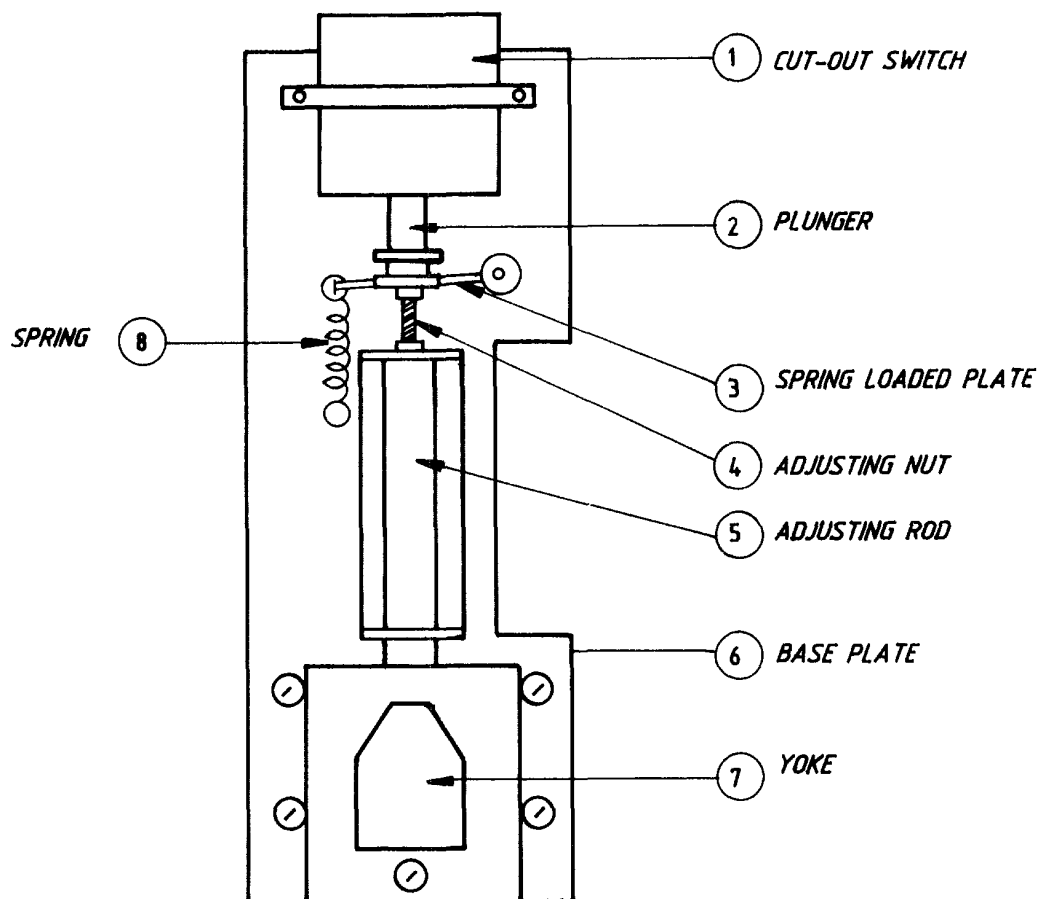
6.5 Lock Slide Assembly

Item No.	Item Description	Manufacturer's Part No.	M.I. No.
1	Lock Slide, Rear	CM267-28/1	
2	Lock Slide, Front	CM267-35/1	
3	Bolt, $\frac{3}{4}$ in. BSW x 2 $\frac{3}{4}$ in. Lg Hex. Hd., Steel, Cad. Plate	M684	
4	Washer, $\frac{3}{4}$ in. Std., Steel	80749	
5	Washer, Spring, $\frac{3}{4}$ in.	4024/6	
6	Nut $\frac{3}{4}$ in. BSW. Hex. Steel	M6928	
7	Lug – Prop	M6344	
8	Bolt and Nut, $\frac{3}{4}$ in. BSW x 2 $\frac{1}{2}$ in. Lg. Hex. Hd. Steel	4150/14	



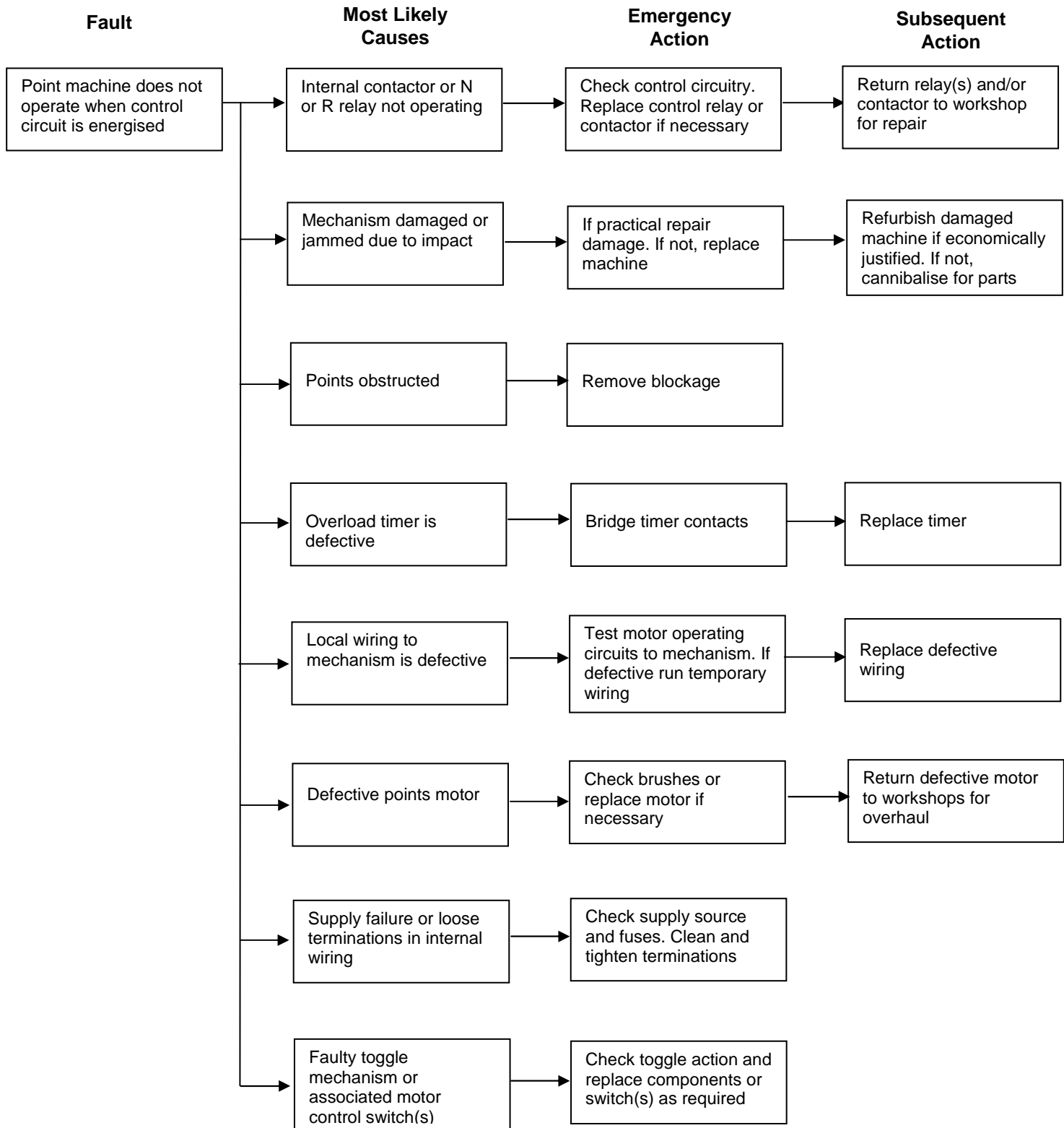
6.6 Cut-Out Switch Assembly

Item No.	Item Description	Manufacturer's Part No.	M.I. No.
1	Cut out Switch	M23867	
2	Plunger		
3	Spring Loaded Plate		
4	Adjusting Nut		
5	Adjusting Rod		
6	Base Plate		
7	Yoke		
8	Spring		

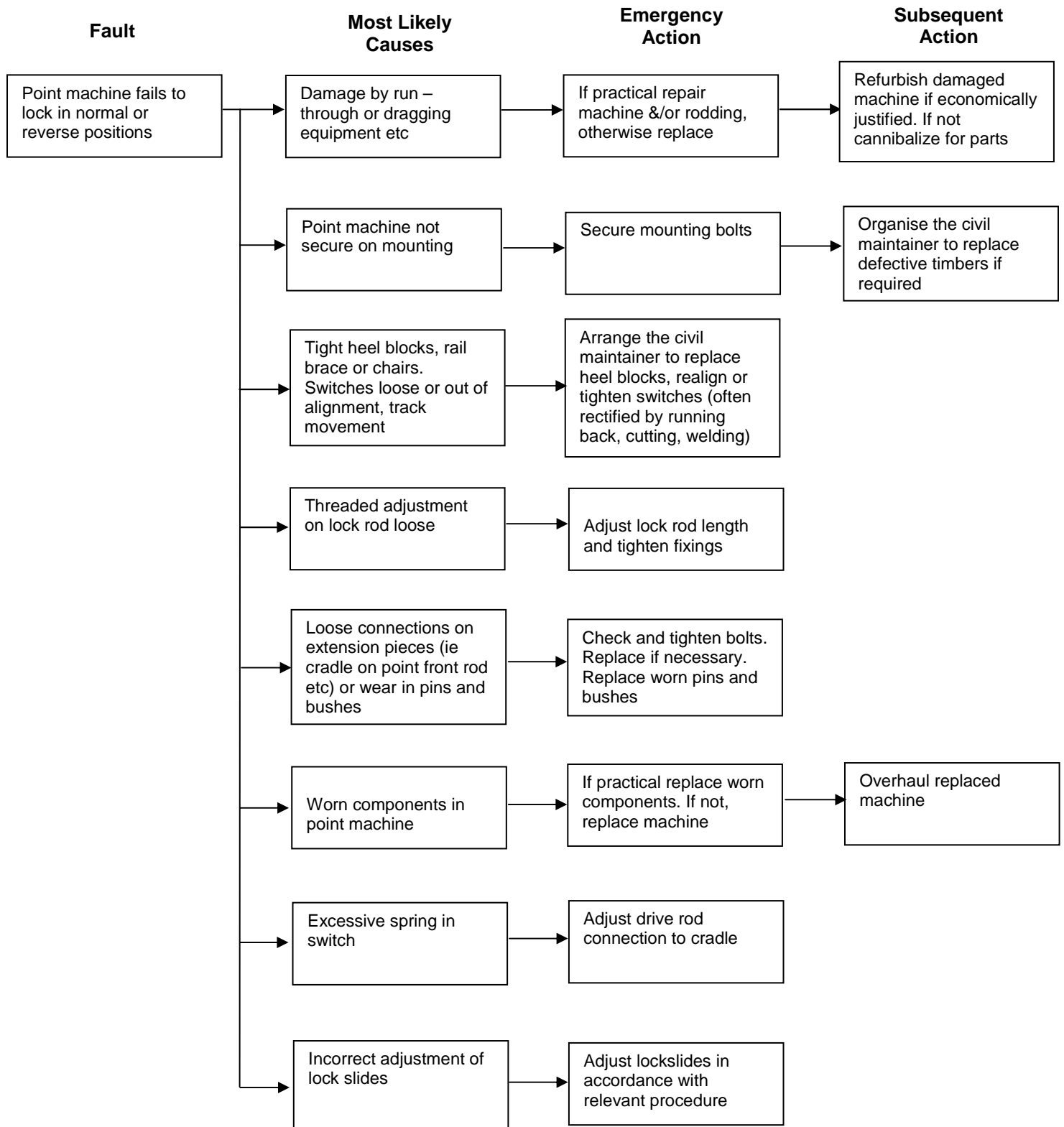


7 Diagnostic Fault Finding Charts

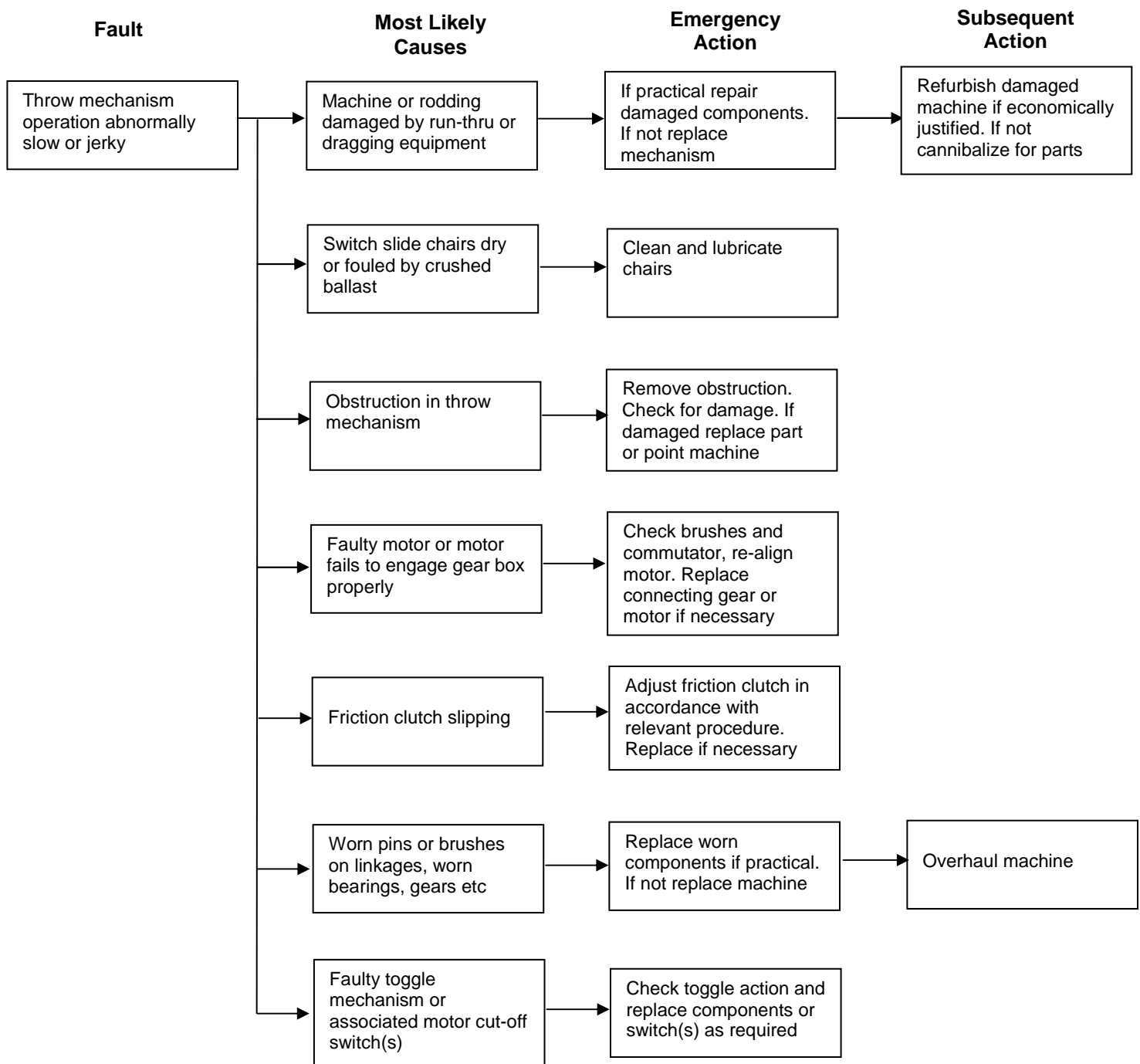
7.1 Fault Finding Chart 1 - Point Machine Not Operating



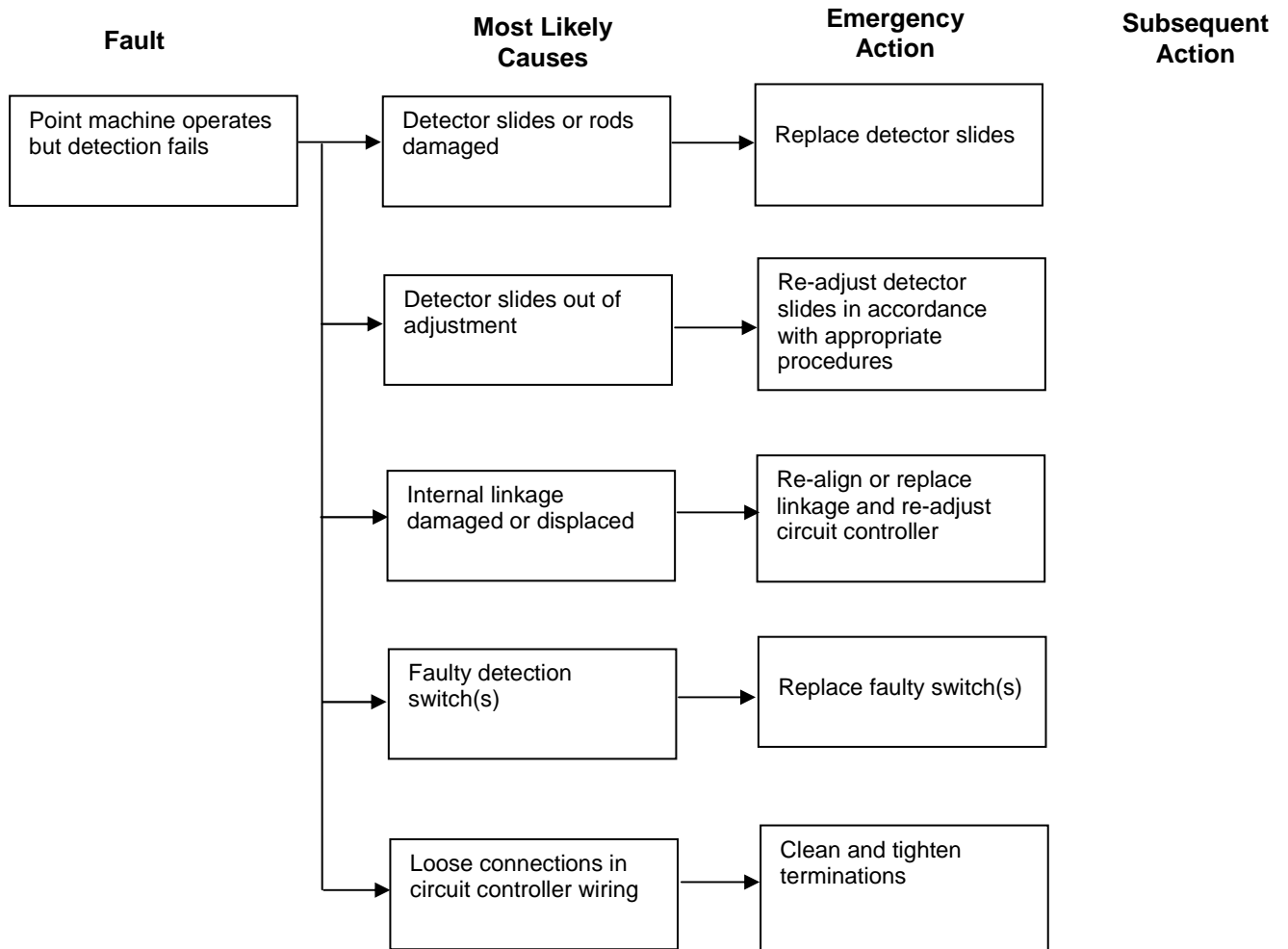
7.2 Fault Finding Chart 2 - Switch Fails to Lock in Normal or Reverse Position



7.3 Fault Finding Chart 3 - Operation of Throw Mechanism Slow or Jerky



7.4 Fault Finding Chart 4 - Point Machine Operates but Detection Fails



7.5 Fault Finding Chart 5 - Point Machine Operates Only in Normal or Reverse Position

